The Electrical World.

Vol. XXIII. NEW YORK, FEBRUARY 3, 1894. No. 5.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

41 PARK ROW (TIMES BUILDING), NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the U. S., Canada or Mexico; other Postal Union countries, $6.

In requesting your address changed, give old *as well as new address.*

Established 20 years ago, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the Largest Circulation of any electrical periodical in the world, and is the Best Advertising Medium.

In the growth of the paper in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits has not failed to be appreciated by advertisers. The following table shows its steady onward march in this department of business. The first issue of

1880	contained	25	different	adv'ts.	1887	contained	154	different	adv'ts.
1881	"	28	"	"	1888	"	175	"	"
1882	"	45	"	"	1889	"	234	"	"
1883	"	66	"	"	1890	"	289	"	"
1884	"	82	"	"	1891	"	325	"	"
1885	"	100	"	"	1892	"	316	"	"
1886	"	138	"	"	1893	"	317	"	"

The first issue of 1894 contained 320 different Advertisements.

No announcements of the Publisher are included in this list.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

41 Park Row, New York.

VOL. XXIII. NEW YORK, FEB. 3, 1894. NO. 5.

CONTENTS.

Editorial 137
The Buckeye Lamp Case..... 138
The American Association of Inventors and Manufacturers... 140
Cheap Telephones 140
The California Midwinter Fair..... 140
The Niagara Falls Power Plant..... 141
A Current Without a Difference of Potential..... 144
Relative Costs of Distribution by Different Electrical Systems. 144
The National Electric Light Association..... 144
Report of the Edison Illuminating Company, of New York.... 144
Magnetic Separator Litigation..... 145
Storage Batteries on the Canals..... 145
Explanation of the Apparent Disagreement Between Certain Magnetic Formula, by Carl Hering..... 146
Another Startling Discovery 147
A Year's Record of Electrical Patents..... 147
Laboratory Notes.—XV., by Lieut. F. Jarvis Patten..... 148
Light and Electricity After Maxwell and Hertz, by H. Poincare 149
Rope Driving.—VII., by J. J. Flather..... 150
Digest of Current Technical Electrical Literature, compiled by Carl Hering 153
What is Thought of the New Form..... 156
Windmills for Electric Lighting..... 157
Automatic Car Brake 158
Storage Battery Traction..... 158
A New Conduit Street Railway System..... 159
The Bain Induction System 160
An Improved Automatic Engine..... 161
DEPARTMENTS:
Financial 162
Special Correspondence 163
News of the Week..... 164
Trade and Industrial Notes 166
Business Notice 167
Illustrated Record of Electrical Patents..... 167

GENERAL ELECTRIC PATENT LITIGATION.

An unassailable patent seems to be about as uncertain as a "straight tip" at the races. Of this the experience of the General Electric Company, in its efforts to sustain the Edison lamp patent, is the latest instance. Of course the mistake of the company was in not being satisfied with a fair royalty from the other lamp manufacturers under the first decision which it secured, which doubtless could have been secured in response to a fair proposition. The General Electric Company apparently expected a vastly greater return by taking advantage to the full of its monopoly, but in deciding to pursue this policy, which it must now see was unwise, it neglected to take into consideration the bitter animosities that would be aroused and the ceaseless litigation that would ensue. As a matter of fact, it has distributed among the disciples of Coke and Blackstone a sum of money that would have enabled it, even in these depressed times, to have continued paying good dividends on its stocks, while the result of the litigation up to the present time must be thoroughly discouraging to the company. Its best friends, including many of its stockholders, would be glad if, profiting by the lesson learned, it would follow the example of the young German Emperor and inaugurate a period of reconciliation and fraternal good feeling by offering to come to a reasonable agreement in regard to its "feeder and main" and other patents now in litigation, instead of continuing to further arouse the intensely combative feeling from which it has experienced such disastrous results in the lamp cases.

THE BUCKEYE LAMP CASE.

It was little thought when the Goebel defense in the Edison lamp litigation was offered that still a greater surprise was in store, but the recent decision of Judge Ricks at Cleveland may in some respects be considered even more sensational than that most startling episode. As will be seen in another column, as far as the Buckeye Electric Company is concerned, the Edison lamp patent has been declared void through the extraordinary mistake of an Edison attorney in endorsing a wrong date on the Edison lamp patent. The decision, it will be noted, is only made to specifically apply to cases in which the alleged infringer can demonstrate that he invested capital upon a belief derived from the endorsement referred to that the Edison patent would expire on Nov. 10, 1893, so that its terms does not apply to any one who embarked in the business subsequent to March 18, 1893, when the endorsement was cancelled. Its effect also is only confined, of course, to those within the jurisdiction of the court which made the decision, although it is quite probable that the same point will be soon brought before other courts. The court considers several interesting points in its opinion. It decides that the dedication of a patent to the public, if legal at the time, is absolute whether the patent has yet years to run, and cannot be revoked at a subsequent date previous to the expiration of the patent. It is also decided that the complainant must abide by the date endorsed by it on the patent, even if the endorsement were not necessary and the date one that the courts have determined has no bearing on the life of the patent, and that it was not incumbent on the defendant to make inquiry in face of this definite endorsement by the complainant. It will also be noted that referring to the view that the patent was absolutely abandoned by the endorsement referred to, several opinions are quoted, which the court states seem to exactly meet the case.

INSTITUTE ELECTIONS.

The friends of the American Institute of Electrical Engineers are doubtless glad to learn from the report, at the last monthly meeting, of the Committee on Revision of Election Rules that an attempt will be made at the next meeting to secure the adoption of such measures as will prevent a recurrence of the equivocal methods employed at the last annual election. The report recommends that balloting envelopes emanating from other sources than the secretary's office shall be marked "unofficial," and that the number of votes in nominations shall be placed opposite the name of each candidate on the "general proposal list." The recommendations might have gone further and prohibited the use of the official head of the institute on unofficial communications, the duplication, typographical and otherwise, of official envelopes, and required that unofficial return ballot envelopes should conform to the institute rule in regard to being distributed unstamped. While it is not probable that any of these devices will again be adopted, yet the future prosperity of the institute demands that thorough checks shall be placed against any possible attempt to again introduce Tammany election tactics, such as were employed last year. The aggravating thing about such underground methods is that any mention of them is likely to be construed into reflections against some of the most highly esteemed members of the body from the unfortunate use of their names by the engineers of the movement, through which they are as much victims in this sense as those directly affected are in another. The action of the institute on the report referred to will be watched with unusual interest, as its defeat could be justifiably construed into an indication that the party responsible for the rejection had no desire to be thus held in check.

WHAT RIGHTS HAVE INVENTORS?

In his recent incandescent lamp decision Judge Ricks quotes with approval from an authority on patent law a statement to the effect that the patent privilege is not a mere reward bestowed upon the inventor for past services—the payment of a debt of gratitude toward one who has already conferred a benefit upon the state; that it is also a purchase by the government, acting on behalf of the whole people, of some new art or instrument capable of beneficial use, for which it recompenses the inventor by securing to him for *a time* its sole enjoyment; and when, without this recompense, it has obtained the invention through his voluntary act, so far from recognizing him as entitled to remuneration, it unhesitatingly appropriates the invention to itself, whatever loss and difficulty may result to an inventor. This is but in line with the entire course of patent decisions in recent years, which brings up the question if, under the innumerable rules of law that have grown up limiting inventors' rights, even the most meritorious patentee, except under exceedingly fortunate and unusual circumstances, can be assured the property in his invention evidently intended by the founders of our patent system. Doubtless all of the countless legal points that can now be marshalled against a patent with a view to having it declared invalid, however equitable a character it may have, date their origin from attempts to take advantage of the patent system to establish unwarranted monopolies. In other words, the honest patentee in his struggles to secure the benefit of his invention, and to protect it from those who would rob him of his profit, is harassed and perhaps undone through legal technicalities whose cause of existence lies in the very element he is fighting. This is on the supposition, of course, that he has been successful in guiding his invention through the technicalities of the Patent Office, but even here he is not on sure ground. The manner in which the Berliner patent was kept in the Patent Office for fourteen years, thus prolonging its life to that extent and stifling all independent invention in that line in the meantime, is far from reassuring. Even if an invention is once safely granted and amply able to run the gauntlet of legal technicalities in the courts, the expense of establishing its ability to do this would ordinarily be so great as to either not be justified by the probable profit to be derived, or, what is more often the case, beyond any means that the inventor, who is seldom capable as a financier, may be able to enlist. It is not too much to say that our patent system at present is in a most unsatisfactory and even chaotic state, and that probably no other branch of Federal administration and law so sadly needs a thorough overhauling. Involved, as at present, in a maze of technicalities, with limitations applied at every turn and expensive legal processes necessary at every step, the protection promised an invention is in effect a mere pretence, and an inventor but little more than a subject for legal fleecing.

The Buckeye Lanp Case.

On Tuesday, Jan. 23, Judge Ricks, of the United States Circuit Court, of Ohio, rendered a decision, abstracted below, dissolving the injunction against the Buckeye Electric Company previously granted to the General Electric Company.

Subsequent to the decision Judge Ricks stated to a reporter that he cannot say how far the logic of his decision will be applied to companies which did not take advantage of the voluntary limitation of the Edison patent before it was revoked. He had received notice that application would at once be made by the Universal Electric Company of Cleveland, a company which did not take such action as the Buckeye company did, to dissolve the injunction against them, and the decision in that case will settle the question as to whether the Edison patent has, in fact, fully expired. He finally stated that the logic of the case seems to be that the patent has expired, and all companies are at liberty to manufacture the incandescent electric lamp.

Mr. F. P. Fish, counsel of the General Electric Company, stated that in 1883 the General Electric Company, acting under a mistake, and believing that the patent might possibly be invalid unless there was some reference to foreign patents on it, secured from the Commissioner of Patents a certificate of correction which was appended to the patent, in which they refered to the foreign patent for the same invention, and stated in substance that the American patent was limited by the foreign patent, in accordance with the United States law. This certificate of correction was removed in the spring of 1893. One of the issues in the Novak case, in which the General Electric Company sought an injunction restraining the use and manufacture of the incandescent lamp, was the validity of the American patent in connection with the English patent. Judge Shipman decided recently in that case that the English patent had nothing to do with the term of the American patent, because it was not, in fact, a patent at all until after the grant of the American patent. Judge Rick's decision, so far as is known, was based upon the contention that although the English patent did not, in fact, limit the term of the American patent, yet the General Electric Company was not allowed to say at the present time, as against the Buckeye company, and in view of the special facts in their case, that its patent did not expire with the English patent, because of the fact that in 1883 this certificate of correction was put upon the patent. It was also based upon the contentions that there were special reasons why the patent, even if good against the rest of the world after the expiration of the English patent, was not good against the Buckeye company. Counsel Fish says Judge Rick's decision will be appealed from, and that in any case it only refers to the company in whose favor it was rendered, on their plea that it was misled by the limitation referred to,

and as a result had largely increased its plant and investment.

The statement of the case recites the history of the Edison patent and of the Buckeye Electric Company, which was organized in February, 1890, upon the supposition that the decision of Judge Bradley in the Sawyer-Man case gave a right in general to the public to manufacture and sell incandescent lamps, and also that the decision of the Deputy Commissioner of Patents declaring the Canadian Edison patent void also terminated the Edison patent in the United States. In the summer of 1891, before the decision of Judge Wallace sustaining the Edison patent, a further search disclosed the indorsement on the Edison patent limiting its life to that of the English patent, which was dated Nov. 10, 1879, in the indorsement, thus making it expire Nov. 10, 1893, whereupon the said company further increased its investment. After the decision of Judge Wallace and pending an appeal the factory continued to manufacture lamps, and shortly thereafter negotiations were opened with a view to a sale or consolidation of interest with the owners of the Edison patent, which negotiations were carried on to February, 1893, during which time the factory was operated with the acquiescence of the General Electric Company. These negotiations having finally failed, the factory was immediately closed until the decision of Judge Hallet, in the Columbia lamp case, when it was reopened until Judge Seamen's decision in the Oconto lamp case, since when it has been closed.

The Buckeye Electric Company therefore claims that by the voluntary act of the owner in its indorsement of the date of Nov. 10, 1879, as the date of the English patent, it dedicated and abandoned its patent to the public after Nov. 10, 1893, when the English patent expired; and that by reason of said action the public generally, and especially the defendant, has made large investments upon the faith of the expiration of said patent at the date expressly selected by the owners thereof, and that the latter are estopped to claim any benefits under said patent against the defendants since Nov. 10, 1893.

The complainants, in reply, file affidavits in which they admit the proceedings relating to the endorsement, but declare that the said proceedings were taken under a mistake at law, and under the advice of eminent counsel, and that the necessary correction was subsequently made. They further deny that the defendant was misled by the negotiations set forth by them, and that they in any way have impaired their legal rights to insist upon a continuation of the injunction. They further deny that the defendant was misled by the Patent Office proceeding referred to, and deny that they are estopped by those proceedings to insist that their patent is in force seventeen years from the date of issue, Jan. 27, 1880.

The court, in considering if the action of the complainants was an abandonment of some right or a dedication to the public of a right conferred, states that the action of the complainants is not in all respects like an abandonment of a point of an invention by a failure to claim all of it, or by a disclaimer in express words of a part of it. In this case the complainant did not disclaim or abandon anything that could be immediately appropriated, but it was not, however, a simple declaration that at the expiration of the shortest foreign patent they would then dedicate to the public the full remainder of is term of seventeen years. If its legal effect was such a dedication to take effect ten years in the future, it would have been a gift or grant which was subject to revocation, but the time for which the patentee was conferred the sole enjoyment of the monopoly is just as much the subject of a dedication and grant to the public as a part of an invention or process. What the complainants asked for was a right to limit a United States patent so that it would expire with the British patent, believing that the said patent would expire Nov. 10, 1893, for if they correctly stated its date, it would by law then expire. Acting upon a belief that this limitation was necessary to the validity of their patent, they fixed the limit for what seemed to them a pressing necessity and a sufficient consideration, and they unquestionably had the power to voluntarily fix such a limit whether the Patent Office was authorized by law or not to make such an official correction. That their proceedings were taken under a mistake of law might give them the right to correct their error by proper application made within proper time, but could not affect their power or right to make such a limitation.

In regard to the claim of the complainant that the public should have investigated the legal effect of the indorsement, the court states that it had the right to accept the complainant's statement and to act accordingly. If they had taken no action whatever, but had relied upon their legal rights as they might subsequently be defined, the public would then have acquired no advantage and the defendant would have acted at its own peril and have had no claim such as they now assert. Even conceding that the act was filed under mistaken advice as to law, and only for such action as the Patent Office might lawfully take, and that the terms in which said action was invoked were such as to put the defendant upon its inquiry as to the law, it was nevertheless a solemn and public act and the complainants are bound by it.

In regard to the claim that the dedication was revoked, and that the action of the commissioner for correction was wholly void and that the surrender of the letters patent for correction was without legal authority and of no effect, the court states that this is not a controversy in which the authority of the complainants to surrender their patent for correction or the commissioner's power to make such correction and to amend the records of the office, are involved.

The defendants contend that whether the Commissioner of Patents had legal authority or not the complainants certainly had the right and power to limit the duration of their own patent and make record of their intention to abandon it to the public on and after Nov. 10, 1893, at the expiration of their British patent. Having done so, and the defendant having in good faith acted on said public declaration, it now contends that the complainants are estopped from coming into court and asserting that such conduct was a mistake as to law, and therefore not binding upon them. This involves the consideration of a question as whether the plaintiff's conduct was a representation as to something it proposed to do in the future, and therefore subject to revocation, or whether it was an abandonment of an existing right. The court quotes several opinions in favor of the latter view and says that the exact question seems to be met by these decisions; conceding, however, that there is doubt as to whether these decisions are conclusive of the controversy, the revocation which the complainants claim to have made is dated March 18, 1893, nearly ten years after their voluntary limitation of the primary patent. If they were in doubt as to the legality of the proceedings in the Patent Office, they should have acted as soon as such mistake was suggested and not waited until the public had acted on their dedication.

As to whether the complainant acted in good faith in regard to the defendant's limitation of the life of their patent, their claim that the capital stock was increased and the capacity for manufacturing lamps enlarged by reason of their belief in the said limitation, is both reasonable and natural, and it seems plain to the court that the complainant is estopped from now claiming that its conduct did not induce such well-defined belief as to the limitation of its patent on the defendant's part. Without deciding how far others not similarly situated had the right to rely upon such conduct on the part of the complainants, or without passing upon the question of how far the public generally acquired rights under the complainant's proceedings in the Patent Office, by which they limited the life of their patent, it is sufficient to find, under the motion, that the defendant by reason of the

circumstances particularly set forth in its motion, did rely in good faith upon the complainant's conduct, and had a right to be, and was in fact, influenced thereby.

The court then considers its right to dissolve the injunction now existing, and concludes that in view of the fact that it would not have allowed the injunction if the facts now relied upon in support of the motion to dissolve it had been available as a defense, it can, upon these facts, now dissolve the injunction. The court concludes that as the case is now presented on the motion to dissolve one of the two parties must suffer loss. If the injunction is continued, the defendant is wholly without remedy. It has shown that it was honestly misled by complainant's conduct, and in good faith made additional investments upon the belief so formed. The complainants cannot complain if, for this reason, the benefit of the doubts expressed are given to the defendant and the injunction is dissolved. If the court is in error as to this conclusion, no great harm can result to the complainant, for if such error is established they can recover for the damages caused thereby, and their right to contest as to other infringers not able to show such meritorious claims to estop as defendant has established, can be asserted without prejudice from this decision.

The American Association of Inventors and Manufacturers.

The third annual meeting of the American Association of Inventors and Manufacturers was opened in Washington, D. C., on Jan. 16 and 17, with an address by President Gatling, showing the progress of the association during the year and giving much valuable information to all interested in inventions.

The Committee on Legislation, of which W. C. Dodge, of Washington, is chairman, reported as to patent bills pending in Congress. Fourteen bills have already been introduced, two of them radical in character—one to change the lifetime of a patent from seventeen to seven years, and the other giving the government the right to cancel any patent upon payment to the inventor or owner of not less than $25,000 nor more than $100,000. The association opposes these bills, and their passage is not probable.

House bill No. 5,014 contains some amendments to the patent law prepared by the association, the important sections of which are as follows:

No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid by reason of its having been patented or caused to be patented in a foreign country less than two years prior to the application for a patent on the same invention in this country, but every such patent hereafter granted shall be limited in duration to the term of seventeen years from the time when the earliest foreign patent commences to run.

That Section 4,921 of the Revised Statutes be amended by adding the following: But hereafter, whenever a patent is alleged to be infringed, patentee or his representatives shall seek remedy by bringing suit against manufacturer or vender of the article alleged to infringe said patent, and shall in no case bring suit against any individual who shall have purchased in good faith article of a regular dealer in the open market for his own use until the patent has been sustained by the court: Provided, that such individual purchaser shall give to patentee or his representative, at his request, the name and residence of the party from whom said article was purchased; and where the damage so claimed is less than $50, plaintiff shall pay costs of suits of both defendant and plaintiff; and provided, also, that this exemption from liability of individual purchasers shall not apply to any corporation or party as to any patented machine or process made or used by them. Actions at law or suits in equity for infringements of patent rights may be brought where the infringement occurs, whether defendant be domiciled therein or elsewhere.

A number of important papers were read before the association, notably the following:

"Needed Modifications of Our Patent Laws," by Walter S. Logan, of New York. He took the ground that the sole ownership in a patent does not rest in the inventor, and that no one should be permitted to allow valuable devices to lie idle for years, but that the law should compel him to put them to use, or in the event that he did not wish to do so himself, it should compel him to grant a license to some other person, appointed by the government, perhaps, who should have the right to use it.

"The Right of Property in an Idea," by Allen R. Foote, of Washington, which paper dealt with the question from an economic standpoint.

"Improvements in the Personnel of the Patent Office," by Arthur Steuart, of Baltimore, in the course of which paper he urged that service in the Patent Office should be similar to that in the army or navy. The duties of the commissioner and the assistant commissioner were so technical and required such a large range of experience and education that only men should be selected who wished to give their life to the work. These offices, therefore, should be removed from politics. He thought also that a system of grades and of pensions would contribute to the efficiency of the office, for it would attract men of ability.

Other papers read were:

"The Material Influence of the Patent System Upon the Farmer and His Duty to Uphold It," by John W. Fairchild.

"The Patent Office," by Thomas Ewing, of New York.

"Procedure in Patent Cases," by Richard Henry Gatling, of New York.

"Proposed Repeal of the Caveat Laws," by F. A. Seely, examiner in the Patent Office.

"Suggested Reform in Patent Practice Concerning the Question of Invention," by Charles M. Higginson.

The following officers were elected:

President, R. J. Gatling, Hartford, Conn.; first vice president, Gardiner C. Hubbard, Washington, D. C.; second vice president, George Harding, Philadelphia, Pa.; third vice president, J. C. Anderson, Chicago, Ill.; fourth vice president, B. H. Warner, Washington, D. C.; secretary and treasurer, George C. Maynard, Washington, D. C. Directors, F. A. Seely, Washington, D. C.; F. A. Pratt, Hartford, Conn.; R. S. Munger, Birmingham, Ala.; Marvin C. Stone, Washington, D. C.; Arthur Steuart, Baltimore, Md.; Albert A. Pope, Boston, Mass.; L. W. Serrell, New York City; John V. Rice, Jr., Edgewater Park, N. J.; Ward W. Willits, Chicago, Ill.

Cheap Telephones,

It is reported that the Metropolitan Telephone Company of New York will hereafter sell the Bell instrument for $2.50.

The California Midwinter Fair,

The machinery of the Midwinter Fair at San Francisco, Cal., was started on Thursday afternoon, Jan. 25, when steam was turned on for the first time and the entire illumination of the grounds is now in successful operation. Mr. W. F. C. Hasson, the electrical engineer of the fair, is to be congratulated on the prompt and effective manner in which he has conducted the electrical part of the enterprise, which has been uniformly in advance of the other features, some of which are yet in a backward state.

They Knew It All, As Usual.

An English contemporary, in referring to the World's Fair, made a remark to the effect that it had been a very good thing for the Americans, as it brought before their notice for the first time the advanced state of electric lighting and electric power, about which they knew very little before they visited the Fair (!). But that from a European point view there were no electrical exhibits of any interest, as there was nothing new there for them! A rather better authority from the home of this journal, and one who came here himself instead of by proxy, expressed his great surprise to us at the marvelous development of electricity in this country, and at the very general introduction of the electric light and railway in so many American cities.

The Niagara Falls Power Plant.

THE great power plant at Niagara Falls, which has been in the course of construction for more than three years, was given its first practical test on Thursday, Jan. 25, when the water from the hydraulic canal was admitted to the wheel pit of the Niagara Falls Paper Company's mill, and pouring down the great penstocks set in motion the mammoth turbines and thence passed through the big tunnel out under the city to the river below the city, more than a mile away. One of the 1,100-h. p. turbines was started, then a second and at last a third, and it is stated that their operation was most satisfactory, the wheels running as smoothly as could be desired. The test was made in the presence of the officials of the paper mill and the of the R. W. Wood Company, of Philadelphia, who built and installed the turbines, and of Prof. Geyelin, who designed them.

At this time a brief review of the work that has already been accomplished toward the utilization of this great power and an outline of what it is hoped may be realized in the near future, may prove of interest.

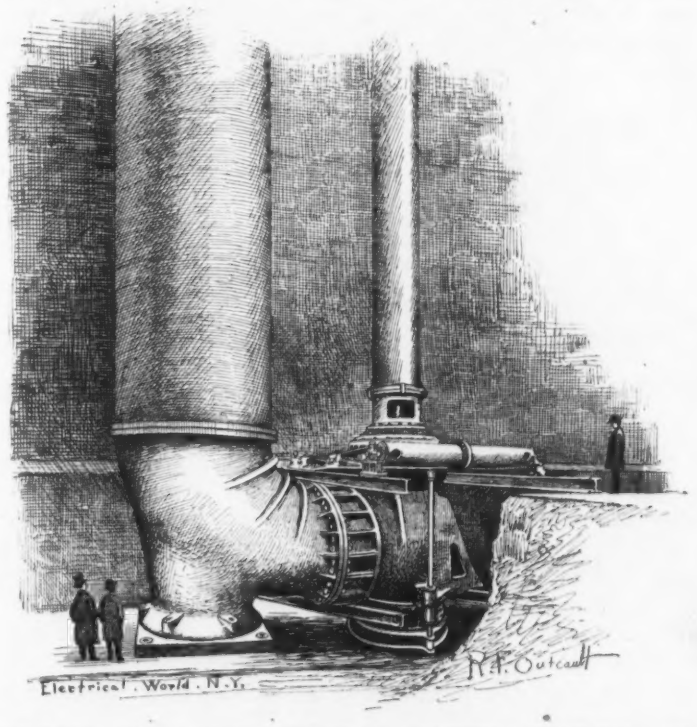
The old hydraulic canal, which commenced on the shore of the river above the falls and extended about three-quarters of a mile to the high bank of the gorge below the falls, was the first attempt to utilize the falls of Niagara on any large scale. During the past sixteen or seventeen years a number of large manufacturing establishments have taken advantage of its resources until its capacity has been practically exhausted.

It was apparent that the power of the great falls could be utilized on a much larger scale, and in 1886 the Niagara River Hydraulic Power and Sewer Company of Niagara Falls, N. Y., obtained a charter under which it planned to construct a tunnel from a point in the Niagara River above the falls along the shores of the upper Niagara River for a distance of a mile or a mile and a half. The present Niagara Falls Power Company is the successor of that corporation. The Cataract Construction Company was organized for the construction of the great work, and secured for carrying out its project the services of the following engineers: Albert H. Porter, engineer; Coleman Sellers, John Bogart and Theodore Turrettini, consulting engineers; George B. Burbank, resident engineer; Clemens Herschell, hydraulic engineer; and George Forbes, consulting electrical engineer.

The chief features of this scheme are well known, and a general idea may be obtained from the accompanying map of Niagara Falls and vicinity. The central feature of the work is the great tunnel, 6,700 feet in length, with a cross-section of 19 by 21 feet. This great piece of engineering work was commenced in October, 1890. The tunnel, which is horseshoe in shape, is lined throughout with brick. Its base at its discharge point below the falls is 205 feet below the sill of the head gate at the entrance to the main canal from the river above the falls. Of this total fall, 140 feet is available, the difference being taken up by the allowance for clearance from the wheel pits, incline of the lateral tunnels, and the grade of the great tunnel, which is about 36 feet to the mile. The tunnel is lined on the invert and sides for a distance of 200 feet back from the discharge point with closely fitted cast iron plates, there being a heavy cast iron frame at the mouth. The brick lining consists of four courses of brick, or a total of 16 inches.

The first establishment to take advantage of this new source of power was the Niagara Falls Paper Company, whose mill was finally put in operation last week, as has already been stated. This company has contracted for 6,600 h. p., half of which has already been installed. The turbines are of the Geyelin-Jouval type, built by R. D. Wood & Co., of Philadelphia, Pa., and are of 1,100 h. p. each.

It is the intention of the Niagara Power Company to lease to various enterprises of sufficient magnitude to establish mills in the immediate vicinity of the canals that right and the privilege of using the great terminal as a tail race. It is certain, however, that it will not be profitable to either the power company or the lessee to install plants of less than 500 h. p., or perhaps 1,000 h. p. for directly utilizing the water power. As the whole 100,000 h. p., which is the rated capacity of the tunnel, could not be thus used, a plan was devised to erect a central power station and transmit the excess of power for use at greater or less distances. Accordingly, Mr. Edward D. Adams, president of the Niagara Construction Company, and Dr. Coleman Sellers went abroad to carefully examine the various systems of power transmission in use there. It was finally decided to place the information in the hands of an international commission, which was organized under the presidency of Sir William Thomson, and consisted of, besides that eminent electrician, Prof. W. C. Unwin, Prof. E. Mascart, Col. Theodore Turrettini and Dr. Coleman Sellers. This commission awarded prizes to various firms offering plans, the most of which were foreign, the Pelton Water Wheel Company, of San Francisco, Cal., and the Norwich Iron Works, of Norwich, Conn., being the two American firms which received recognition. In the summer of 1892 Prof. Henry A. Rowland, of Johns Hopkins University, was asked to make a report upon the various

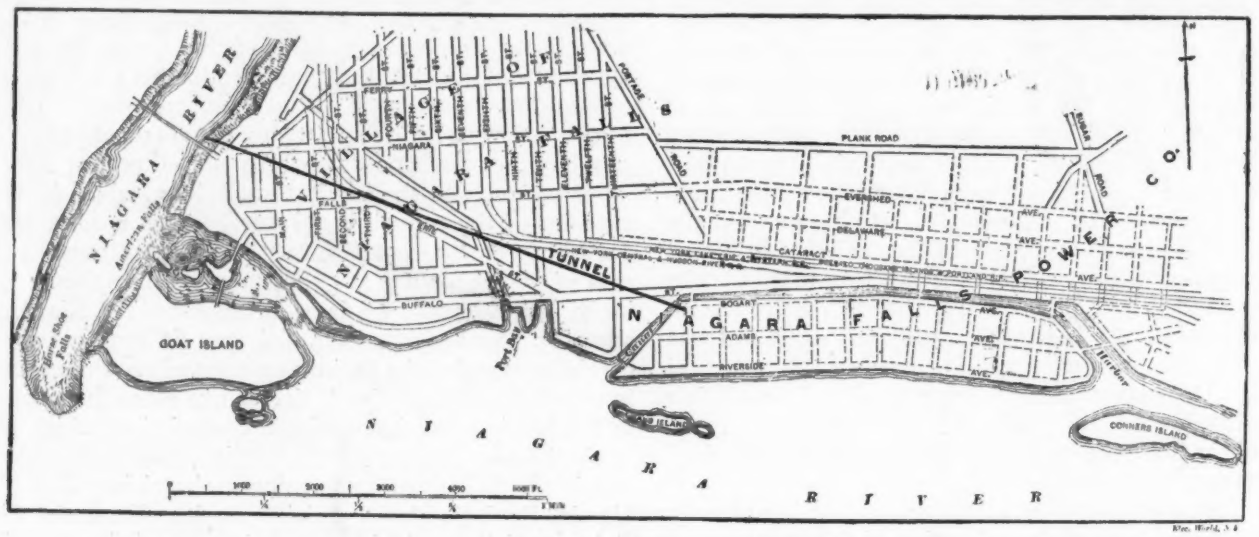


TURBINE FOR THE CENTRAL POWER STATION AT NIAGARA FALLS.

plans proposed, which he submitted about six months later. The officers of the company finally decided upon a general scheme, the principle details of which were made public some weeeks ago.

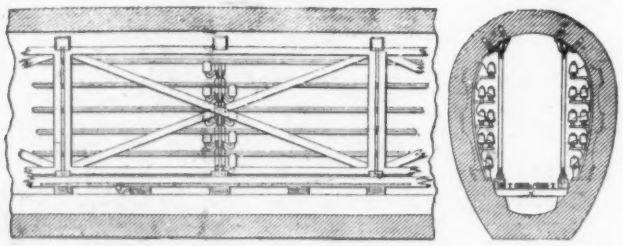
The accompanying illustration gives a very good idea of the general plan of this plant. The ultimate capacity of the station is 50,000 h. p., but as yet the contract has been let for only about one-third of this amount. Five hundred h. p. twin turbines under a head of 140 feet are to operate Westinghouse alternating dynamos of approximately the

same capacity direct connected to the head of a vertical shaft. These turbines have been constructed from designs furnished by the Swiss firm of Faesch & Piccard and built by the I. T. Morris Company, of Philadelphia. The accompanying illustrations show their general form of construction. The speed, under a 140-foot head, is to be 250 revolutions per minute. Bronze is the material used in their construction, similar in quality to that employed for the propellers of steamships.



MAP OF NIAGARA FALLS AND VICINITY, SHOWING LOCATION OF TUNNEL.

The power station is situated on the west side of the main canal, which is about 188 feet wide and 17 feet deep at the river, narrowing to 116 feet in width, but maintaining the same depth throughout its entire length of 1,260 feet. The depth of the water in the canal will be about 12 feet. The sides of the canal are built of solid masonry, seven feet thick



LONGITUDINAL AND CROSS SECTION OF ELECTRIC CONDUIT.

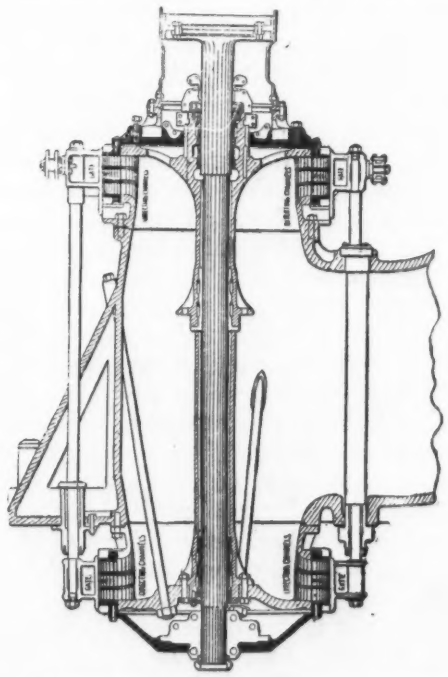
at the bottom, tapering to three feet at the top, on which a coping 2 1-2 feet wide has been placed. From this canal the water is taken through a separate inlet for each wheel, as shown in the illustration, and carried through a penstock seven feet in diameter into the centre of the turbine. It is thence discharged through directing passages upon the 32 multiple blades of the wheels, these passages being formed by 36 deflecting plates.

As has been stated, the shaft is vertical, which gives the wheels a horizontal position, one at the top and one at the bottom of each casing. The gates controlled by the governor are made to govern more or less of the discharge, opening according to the power required. It is claimed that the governor will control the speed under ordinary conditions with a variation of less than one-half of one per cent. One of the most serious problems in the construction of this plant was that of supporting the weight of the long vertical shaft with the moving parts of the dynamo and the great downward pressure on the column of water in the penstock.

This is solved in this design by closing the bottom of the casing so that the water cannot act downward upon any of the parts attached to the shaft, while in the upper end of the weight of the revolving shaft, which is thus nearly in the condition of a shaft spinning upon the water.

The shaft consists of a steel shell about a foot in diameter, with smaller solid portions in the journals, which require to be of less frequency on account of the stiffness due to the large diameter of the hollow shaft. The latter is of rolled steel tubing without any visible vertical seam. No flywheel is required.

We are indebted to "Power" for a considerable portion



SECTION OF TURBINE FOR NIAGARA POWER PLANT.

of the above information in regard to the details of the construction of the turbines.

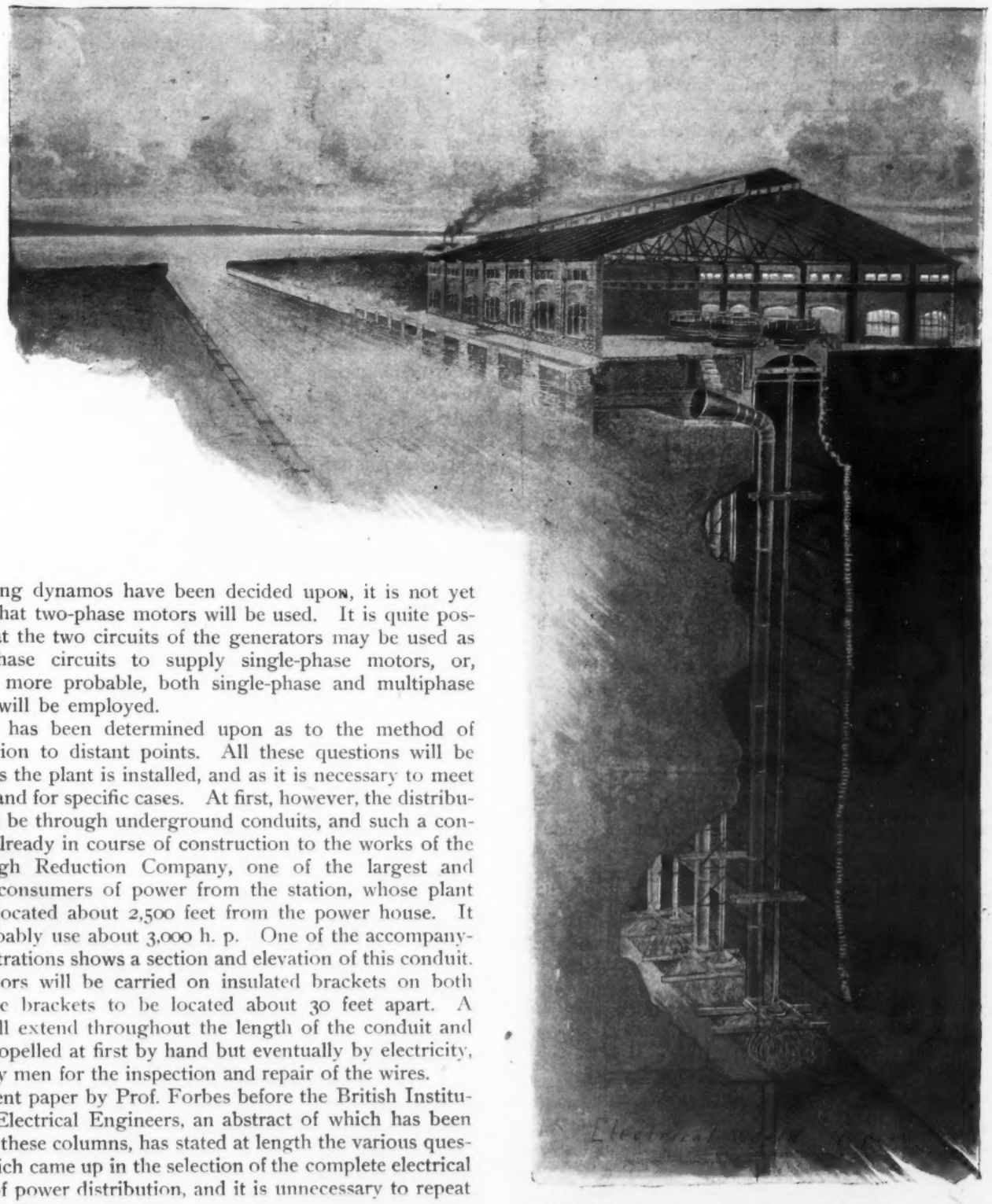
The turbines have been constructed, and it is understood are ready to be placed in position, but the electrical portion of the plant is far from completion, although it is stated that

the whole installation is to be finished by June 1. As already announced in these columns, the contract for the generators was given to the Westinghouse Electric and Manufacturing Company, and these machines are now being constructed at their factory. They are to be of 5,000 h. p., and are two-phase machines, with stationary armatures and rotating fields, designed to give a potential of somewhere in the neighborhood of 2,000 volts, which for long-distance transmission will be increased by step-up transformers. The electric features of the plant are by no means settled. Although two-phase alternating dynamos have been decided upon, it is not yet settled that two-phase motors will be used. It is quite possible that the two circuits of the generators may be used as single-phase circuits to supply single-phase motors, or, what is more probable, both single-phase and multiphase motors will be employed.

Little has been determined upon as to the method of distribution to distant points. All these questions will be settled as the plant is installed, and as it is necessary to meet the demand for specific cases. At first, however, the distribution will be through underground conduits, and such a conduit is already in course of construction to the works of the Pittsburgh Reduction Company, one of the largest and earliest consumers of power from the station, whose plant will be located about 2,500 feet from the power house. It will probably use about 3,000 h. p. One of the accompanying illustrations shows a section and elevation of this conduit. Conductors will be carried on insulated brackets on both sides, the brackets to be located about 30 feet apart. A track will extend throughout the length of the conduit and a car, propelled at first by hand but eventually by electricity, will carry men for the inspection and repair of the wires.

A recent paper by Prof. Forbes before the British Institution of Electrical Engineers, an abstract of which has been given in these columns, has stated at length the various questions which came up in the selection of the complete electrical system of power distribution, and it is unnecessary to repeat the details here.

The Cataract Construction Company, which has charge of the engineering work, will finish its labors when the plant has been completed, and will then hand it over to the Niagara Falls Power Company, which is the central figure of the whole scheme. Various auxiliary companies have been organized for different purposes. The Land Development Company is to erect a whole village on the extensive lands acquired. The Niagara Railway Company is to construct six miles of terminal railways to connect the factories, as they are built with the railways in the neighborhood. Other companies, such as the Cataract General Electric Company, is to supply power to all the cities within reach. Roads are made, leases of land granted, factories built and the engineering work taken in hand by the Cataract Construction Company, of which E. D. Adams is president, E. A. Wicks first vice president, W. K. Rankine secretary and treasurer. Mr. G. B. Burbank is chief engineer; Dr. Coleman Sellers acts both as consulting engineer for the Cataract Construction Company and as president of the Niagara Falls Power Company, while undertaking at the same time many of the duties of a resident engineer.



NIAGARA FALLS CENTRAL POWER STATION.

A Current Without a Difference of Potential.

BY WILLIAM A. ANTHONY.

In the last issue of The Electrical World is given a case of "A Current Without a Difference in Potential." Permit me to call attention to a case about which there can be no question, which will be found described in text-books of more than twenty years ago. Suppose a conductor of uniform cross-section, bent in the form of a circular ring and the ends joined, forming a conducting ring of perfectly uniform cross-section and conductivity. Let a straight bar magnet whose axis coincides with the axis of the ring be thrust into the ring along its axis. An electromotive force of uniform value acts in every element of the ring and develops a current, but with no difference of electrical potential in any part.

Another Case of a Current Without a Difference of Potential.

In connection with the note under this heading, in last week's issue, attention might be called to another case. If a copper ring be placed above a coil through which an increasing (or decreasing) current passes, a current will flow in the ring the relations of which to the ring would be similar to those in the supposed case mentioned last week. That there will be a true E. M. F. generated in this ring by the increasing flux is evident.

Relative Costs of Distribution by Different Electrical Systems.

The following letter has been received from Mr. Paul A. N. Winand:

"Your number of Jan. 13 contains a paper by Mr. W. D. Weaver on the relative cost of distribution by different electrical systems with the same effective or maximum E. M. F. I beg to remark in this connection that in a paper, read in May, 1892, contained in the journal of the Franklin Institute for October and November, 1892, and reprinted in part in The Electrical World, 1892, page 310, I have dealt with the same question, and arrived, in a very simple way, at substantially the same conclusions as Mr. Weaver. The only discrepancy in the conclusions is referring to the so called two-phase system. My figure for this is identical with that also found by Mr. G. Kapp."

(The paper referred to by Mr. Winand, "On Polyphased Currents," we find considers a number of interesting points in connection with polyphased currents, including efficiency of transmission and relative amounts of copper in different systems, and thus antedates Kapp's paper on the latter subject by more than a year. While the method used is comparatively simple in expression, the attempt to avoid analytical mathematics has resulted in somewhat involved explanations and a less general treatment, thus rendering the paper rather difficult reading, which may account for its undoubted value not having been more generally recognized.)

The National Electric Light Association.

An invitation has been sent by Secretary George F. Porter to the various central stations throughout the country to attend the seventeenth convention of the association, which is to be held at Washington on February 27, 28 and March 1, in which it is announced that among the topics of discussion will be the following:

"What Is the Most Economical Size for Arc Dynamos?" "Arc Lights on Incandescent Circuits." "How to Rate Arc Lamps." "Underground Circuits." "How to Wire Buildings." "Commercial Alternating Motors." "Electrolytical Effects of Return Currents," "Meters vs. Flat Rates" and "Storage Batteries." A paper entitled "Electric Lighting at the World's Fair and Some of Its Lessons," illustrated with stereopticon, by T. C. Martin and L. Stieringer; "Impressions of a Central Station Man Abroad," by E. A. Leslie; "The Importance of Complete Metallic Circuits for Electric Railways," by J. H. Vail, and other papers will be read.

Mr. C. O. Baker, Jr., master of transportation, announces that the Boston Passenger Committee and the Southern Passenger Association have granted a rate of one and one-third fare for a round trip from points in their respective territory for members and delegates attending the convention.

Report of the Edison Illuminating Company of New York.

The Board of Directors of the Edison Illuminating Company of New York have issued their annual report, in which it appears that the year 1893 was a most prosperous one for the company. The net earnings of the company's stations were $666,027.23, while the earnings from other sources and income from investments amounted to $52,185.96, making a total of $718,213.19. The general and legal expenses and taxes amounted to $112,570.47, leaving as the net earnings of the company for the year $605,642.72. The gross earnings increased 27 1-2 per cent. and the net earnings 27 per cent over those of 1892. The business depression tended to curtail the number of lights per customer, but on the other hand the company largely increased the number of customers. The total present installation is equal to over 270,000 16-c. p. incandescent lamps. The installation of incandescent lamps increased 25 per cent., of arc lamps 55 per cent. and of motors 45 per cent. The following table shows the net increase in the several classes of installations for the past three years:

	Dec.31, 1890.	Dec.31, 1891.	Inc., 1891.	Dec.31, 1892.	Inc., 1892.	Dec.31, 1893.	Inc., 1893.
Customers	1,698	2,875	1,177	4,344	1,469	5,154	810
Inc. Lamps.....	64,174	94,485	30,311	142,492	48,007	192,691	50,199
Arc Lights.....	254	841	587	1,637	796	2,538	901
Motors, h. p.....	697	2,000	1,303	3,807	1,807	5,529	1,722
Total 16 c. p. eq.	73,684	122,895	49,211	196,932	74,037	273,361	76,429

The number of customers would have increased still far more but for the fact that during part of the year the company was obliged to refuse business on account of its limited capacity.

The new Pearl street station has been completed during the year in its exterior, but the financial depression limited the interior work to that necessary for immediate requirements of the station. Five of the new double-deck Babcock & Wilcox boilers, adapted for 200 pounds' working pressure of steam, are in use in the boiler room, and a new 2,500-h. p. Van Vleck disconnective quadruple expansion engine, with two 800-kw. dynamos, have been installed in the engine room. The old Pearl street station was not dismantled during the year, as was hoped, but it is expected that the station will be put out of service early this year and the whole installation concentrated in the new station, which is now capable of producing over 30,000 amperes. The 26th street station has been equipped with its full complement of machinery, and has now a rated capacity of about 20,000 amperes. The 39th street station has been further equipped, and, with a rate of capacity of 6,500 amperes, has been run supplementary to the 26th street station. The 53d street station has had an additional boiler equipment during the year, and with its storage battery plant has now a capacity of 4,500 amperes. When the old Pearl street station is discontinued part of this equipment will be moved to the 53d street station.

The highest load of the entire system taken together was on Dec. 15, a maximum of 51,480 amperes, and the total amperage of the year was in the down-town district, 47,317,512 ampere hours, and in the up-town district, 43,812,810, making a total of 91,130,322 ampere hours.

The report also deals with the underground installation, the work of the inspection department, the meter bureau and the lamp decisions. The company has made rapid progress in the arc light business, and now claims an arc light installation larger than that of any high-tension company. During the year the new arc light street system of Fifth avenue has been extended and the use of small arc lamps for interior lighting has been noticeably developed.

Magnetic Separator Litigation.

Judge Acheson, of the United States Circuit Court of the District of New Jersey, has handed down a decision sustaining a claim of infringement by the Magnetic Separator Company against the International Ore Separating Company. The court decides that the latter company has infringed various patents of Clinton M. Ball, of Troy, N. Y., and others, relating to the separation and concentration of iron ores, of which the essential elements are: a method of three-part separation, the method of forcing ore in a state of division through an alternating magnetic field with full opportunity for the dislodgment of gangue, air currents for removing the finer particles of dust from the ore, and means for adjusting the strength of the magnetic field. Orders are granted to recover profit, gains and advantages from such infringement, and that the defendants pay the costs of the suit and be perpetually restrained from further use of said inventions.

Storage Batteries on the Canals.

Mr. Frank W. Hawley, who had charge of the canal electrical experiments near Rochester in December last, will ask permission of Superintendent of Public Works Hannan to operate his boat on the State waterways next season as a sort of object lesson in the uses of electricity. He proposes to have a new boat of the most approved pattern, equipped with a propeller wheel of the latest design, and in place of the trolley used in the experiments already mentioned, proposes to use storage batteries to operate the Westinghouse motors that drive the shaft to which the wheel is attached. Two series of storage batteries will be used. On one side of the boat will be ranged the chloride accumulators of the Electric Storage Battery Company, and on the other side a series of batteries furnished by the General Electric Launch Company of New York. It is the intention to place upon this electric boat a number of devices for the use of electricity in daily life, including electric heating and cooking apparatus, and to exhibit these everywhere along the line of the canal, thus furnishing a useful object lesson. Mr. Hawley deserves the warm thanks of the electrical profession and industries for his enthusiastic faith in the possibilities of electricity and the yeoman's service he is performing in thus unselfishly advancing its interests.

Unipolar Dynamos, and the Action of Lines of Force in a Revolving Electromagnet.

BY A. RANDOLPH.

The article in The Electrical World, Jan. 13, by Mr. Carl Hering was interesting to myself, and no doubt it was to others also who, like myself, have been fascinated with the idea of a possible operative unipolar dynamo. Mr. Hering states regarding an electromagnet that "it was thought that if an iron core in a coil be revolved, the coil remaining fixed, the lines of force would move with the iron, and not remain fixed with the coil. But this also appears to be an error, as lines of force are said to remain and move with that which generates them; that is, with the coil of an electromagnet; they are stationary if the coil is stationary, and revolve if the coil revolves." "This statement is made, however, on the authority of others, the writer not having made any experimental demonstration himself." I think that the above statement is incorrect, and that dynamos have been made which operated, and yet the only part of the magnet which revolved was the core and poles. In The Electrical World of Sept. 30, 1893, page 247, is described and illustrated a motor exhibited at the World's Fair by the Union Electric Company, called the Main motor. It has a stationary Gramme ring armature, the windings of which are connected to a stationary commutator; the magnet coil is stationary and the core and poles revolve. The magnet has four poles, which face the sides of the armature. Each pole face covers but a part of the side of the armature, and the two pole faces on one side of the armature are set one-fourth the circumference ahead of the two on the other side.

In this machine the lines of force must* follow the iron of the magnet and sweep around through the armature core as the magnet revolves, so that the stationary wires on the armature are not cut by the lines of force, or it would not be operative.

This is good experimental evidence* that the lines follow the iron of the magnet even though the magnetizing coil be stationary.

The Mordey alternating-current dynamo is well known to most of the readers of The Electrical World, and it has a revolving magnet, but the coil revolves with the magnet. S. R. Bottone is authority for the statement that this dynamo will operate all right if the exciting coil is stationary, but that it is not so made because of mechanical difficulties. The writer has made some experiments with a supposed unipolar dynamo, the magnet of which was of a shape similar to the Mordey magnet, but one end of it and the core and exciting coil was stationary, while the other poles revolved. The machine was not operative and the experiments were not carried very far, but as the result of this experience I conclude that if only one pole of the magnet revolves it is probable that the lines do not revolve with the pole, but pass directly through the air and iron in the shortest course to the core, or if they revolve with the moving pole they sweep through the air and take the shortest course to the core again through the iron and air, instead of all entering and passing through the stationary poles to the core. In either case I do not think it will make any difference whether the magnetizing coil is stationary or revolves with the movable pole of the magnet. Possibly some one has settled these points by experiment, and if so, I would be pleased to see them contribute the same to the columns of this journal, but if no one can refer me to any such experiments, I will not be satisfied until I do something toward it in the future.

(*The writer's mistake lies here. This machine does not necessarily prove that the lines really revolve with the core, for it evidently would also work if the lines remained fixed with the coil, being alternately strengthened and weakened through successive parts of the armature: if the pole pieces heat less when the coil also is revolved, it would tend to show that the lines remain fixed with the coil. But even this would not be conclusive, as the lines due to the iron might revolve with the iron while those due to the coil itself might remain stationary with the coil. We know of a similar machine in which the pole pieces heated so very much that the machine was of no use.—C. H.)

Surgical Electricity.

The curious and possibly important fact, says London "Electricity," has been noticed that when the eyes are illuminated from behind by a glow lamp in the mouth, the pupils, seen as blood-red apertures, do not contract.

Explanation of an Apparent Disagreement Between Certain Magnetic* Formulas.

BY CARL HERING.

TO the inquiring mind there appears to be a disagreement between two very common and useful formulas, and as both are undoubtedly correct, it often leads the careful student to believe that he does not fully understand them, and he may therefore be afraid to use them. It is for the benefit of this class of thinking students and beginners that the following explanation is offered. Those who are thoroughly conversant with the subject will, of course, see at once that the disagreement is only apparent and not real.

We are told that for a coil without iron the formula for the number of lines of force per square centimetre is

$$H = \frac{4\pi}{10} A\, t, \qquad (1)$$

in which A is the number of amperes and t the number of turns per centimetre length of the coil. We are also told that for the same coil without (or with) iron the identical formula gives the value of the magneto-motive force thus:

$$\text{M. M. F.} = \frac{4\pi}{10} A\, t, \qquad (2)$$

in which M. M. F. represents the magneto-motive force (which may be considered as that which causes the magnetic flux, just as the E. M. F. is that which causes the electric current). From these two identical formulas it appears as if H, which represents the number of lines per square centimetre, was the same thing as a M. M. F., which, however, is measured in entirely different units; or, to use analogous quantities in electricity, it appears as if a current density in a wire was the same thing as volts, which is naturally quite confusing. Even if it is known that H is really a M. M. F., the question arises, Why is its value always expressed in lines of force per square centimetre, which is an entirely different unit from the unit of M. M. F.? The numerical value of H in that formula is almost invariably stated as meaning a certain number of lines per square centimetre, or in terms of the new names which are about to be introduced in this country, its numerical value represents so-and-so many gausses. But the M. M. F. is measured in gilberts, and it might seem, therefore, as if gausses were equal and synonymous with gilberts, while they are really as different as current densities and volts.

The explanation of this apparent disagreement is that the first formula, although the more common, is really only a special case of the second, the special condition being that the reluctance or magnetic resistance is unity, and therefore does not appear in the formula. The second formula is quite general, applying to air, iron, steel, bismuth, etc., while the first applies only to one particular case, namely, air. Although the last condition, namely, that the formula for H applies only to air, is generally (and should always be) stated, yet this is not sufficient to make the true difference between the two self-evident; it is asked, "If the difference is in the reluctance, then why does not the reluctance appear in the second formula either?"

To illustrate how two different quantities may be numerically the same, let us take an analogous case. Volts and amperes are entirely different quantities, yet if a wire has a resistance of one ohm per foot, then the *number* of volts for a certain number of feet will be the same as the *number* of amperes. A more perfect analogy will be given later We will first show, for the benefit of those who desire to see the true meaning of the magnetic formulas, how they may be reconciled with each other.

Quite analogously to Ohm's law there is a well-known formula in magnetism:

$$\text{flux} = \frac{\text{M. M. F.}}{\text{reluctance}}, \text{ or webers} = \frac{\text{gilberts}}{\text{oersteds}},$$

or using letters for the sake of brevity,

$$\Phi = \frac{\mathfrak{F}}{\mathfrak{R}},$$

which is quite general and applies to coils with or without iron or any other substance. From this it follows that $\mathfrak{F} = \Phi\, \mathfrak{R}$, but as was stated in formula (2) $\mathfrak{F} = \frac{4\pi}{10} A\, T$, in which, in order to make it more general, we have used the total number of turns T instead of the number of turns t per centimetre. From this it follows that

$$\Phi\, \mathfrak{R} = \frac{4\pi}{10} AT, \text{ or } \Phi = \frac{4\pi}{10} \frac{AT}{\mathfrak{R}}.$$

But Φ is the total flux in the coil (in webers), and must, therefore, be divided by a cross-section s to reduce it to lines of force, or flux, per square centimetre (in gausses); we can then represent it by H', as it is then a quantity of the same kind as H, namely intensity. Thus

$$\frac{\Phi}{s} = H' = \frac{4\pi}{10} \frac{AT}{\mathfrak{R}\, s};$$

substituting for $\mathfrak{R}$ its value $\mathfrak{R} = \frac{l}{s\,\mu}$, in which l is the length of the magnetic circuit in centimetres and μ is the permeability, gives

$$H' = \frac{4\pi}{10} \frac{AT s\mu}{s\, l} = \frac{4\pi}{10} A \frac{T}{l} \mu.$$

So far it is still quite general, but we now come to the special case of a long solenoid without iron, in which the permeability $\mu = 1$ and $\frac{T}{l} = t$, the number of turns per centimetre, in which case H' becomes H; making these substitutions gives $H = \frac{4\pi}{10} A\, t$, which is the original formula (1). It will thus be seen how two formulas which are identical may, nevertheless, give values of two quantities which are totally different in quality.

For the advanced student who is more familiar with mathematical reasoning, the above detailed explanation may be reduced to a few words. Taking a very long solenoid with an air core, the flux density (in gausses) will be the same in any part of a cross-section, not too near the ends; hence a cylinder one centimetre long and one sq. cm. in cross-section, with its axis parallel to that of the solenoid, will, when placed anywhere on this cross-section, always enclose the same number of lines, and the M. M. F. at its ends will be that given by the formula (2); from the other formula $\mathfrak{F} = \Phi\, \mathfrak{R}$, it follows that $\mathfrak{F} = \Phi$ if the reluctance $\mathfrak{R}$ of this cylinder is unity; but as the cross-section is also unity $\Phi = H$, hence $\mathfrak{F} = H$, that is the numerical value of $\mathfrak{F}$ (in gilberts) is equal to that of H (in gausses).

Strictly speaking, however, H is really a magneto-motive force (expressed in gilberts) and not an intensity (expressed in gausses), and if thus considered there is no disagreement at all between the two formulas. But owing probably to the easy conception of lines of force per square centimetre and to the more difficult and unusual conception of a magneto-motive force, it has become popular to represent H as an intensity in this particular case; hence the apparent disagreement. But it should be clearly under-

* The term "magnetic" formula is used here in place of the more correct but rather lengthy expression "formula for calculating magnetic quantities and relations"; the term is quite analogous to the terms electric, chemical or hydraulic formulas, and its use therefore seems justified.

stood that such an interpretation of H is allowable only nnder particular conditions. If a uniform system of notation had been in use, no such confusion would have arisen.

Students who are fond of analogies will find the following to be quite a perfect one to the above magnetic calculations. Volts are analogous to magneto-motive force (gilberts), and current density is analogous to the H as it is usually represented (that is to gausses). In general the volts generated in a wire moving through a magnetic field are represented by the formula

$$E = \frac{N}{10^8\, n},$$

in which N is the flux (in webers), or the total number of lines of force, and n the number of seconds in which the wire cuts them. Now, under certain definite conditions the current density ($C\,d$) in the wire might also be (although it never is) represented by precisely the same formula, namely,

$$C\,d = \frac{N}{10^8\, n},$$

from which it might appear as if $E = C\,d$; that is, as if current density and volts were the same thing, which we know they are not. By substituting the above value for E in Ohm's law, and also the value for R in terms of the length, cross-section and specific resistance, and then dividing the resulting equation by the cross-section of the wire (quite analogously to the reductions made above with the magnetic formulas), we will obtain

$$C\,d = \frac{N}{10^8\, n}\,\frac{s}{l\,r},$$

which in the special case of r (specific resistance) and l (length of wire) being unity, as in the magnetic formula, will give the same value as that for E.

If we may be pardoned for following an old custom of drawing morals, the following would fit the above case: 1. Things which are numerically equal to the same thing are equal to each other *numerically, but not necessarily qualitatively*. 2. Authors of formulas will do less harm by being too explicit than by not being explicit enough.

Another Startling Discovery.

According to a German journal whose title leads one to believe that it is a scientific paper, a physician in Geneva, named Mandeuft, has made a wonderful discovery, which, as is usual with these discoveries, will completely revolutionize the present methods of generating electricity. With a 1-2-h. p. machine he claims to be able to light 500 lamps, the candle power of which, however, is not given. The apparatus consists of a hollow sphere of zinc about 20 inches in diameter and a solid sphere of copper inside of it about 16 inches in diameter; the outer one is revolved in one direction and the inner in the other, the speed being 500 revolutions per minute. But, the article states, no current is generated until the space between the two spheres is filled with water vapor at a pressure of 6 atmospheres, when a current of "enormous power" will be produced, whose intensity increases with the speed of revolution and the pressure of the steam. As usual, the first apparatus which has been tested in England is said to have been very satisfactory, even to scientists, the names being unfortunately omitted. The article ends up with what constitutes an advertisement of somebody's accumulator and somebody else's thermo-stove.

Nothing New Under the Sun.

"La Lumiere Electrique" announces as something new that an incandescent lamp was recently found in the stomach of a shark, but a Hering tells us that long ago he experienced the sensation of a vacuum in his stomach.

A Year's Record of Electrical Patents.

BY C. W. SWOOPE.

Since the organization of the Patent Office and up to the present time over half a million patents in the application of the arts and sciences have been granted by the government to individuals. A very large proportion has been granted during the last decade, there having been over 100,000 patents issued in the past four years, against 140,000 issued for the ten years 1870 to 1880, so that the present time may well be called the "Age of Inventions."

During the past year over 22,000 patents were issued, of which more than 1,700, or 8 per cent., were issued for electrical inventions, which is a slight increase over the number issued the preceding year. To give some idea of how this number of patents is distributed over the various branches of the electrical business, as well as indicating the subjects which are engaging the attention of many inventors, the following statistics have been carefully compiled from the "Illustrated Record of Electrical Patents," as published each week by The Electrical World:

	Number of patents issued.	
Electric Traction.		
Electric railway systems and conduits	84	
Trolley and car appliances	104	
Electric locomotives	25	
		213
Dynamos, motors and parts thereof		164
Electric lighting fixtures and appliances		140
Regulator and current controlling apparatus		81
Cut-outs and circuit breakers		58
Arc lamps		77
Incandescent lamps		39
Systems of distribution and switchboards		64
Switches		66
Wires and cables, conduits		26
Insulators		50
Electric measuring instruments, meters, indicators, etc		85
Telephones		83
Telegraph		45
Signal systems		88
Bells, annunciators, gas-lighting clocks		79
Fire alarms		35
Batteries.		
Primary	36	
Secondary	37	
		73
Electric heating and appliances		40
Electric welding		18
Electric mining		13
Medical apparatus		25
Miscellaneous devices and appliances		158
Total		1,720

One thing especially noticeable in the table is that our every-day practical apparatus is being constantly improved and perfected, which of course means better service for the public. As will be seen, the subject of electric traction is paramount, claiming the largest share of attention from inventors, 9 per cent. of these patents being issued to foreign residents. Arc lamps continue to be improved, though 20 per cent. of these patents were issued to foreigners.

Quite a number of patents classed under lighting appliances related to lightning arresters, this subject apparently receiving considerable attention.

Patents relating to the transmission of power were classed under dynamos and motors and systems of distribution, and received a fair percentage. This subject, no doubt, will soon rival that of electric traction, and promises much for the future.

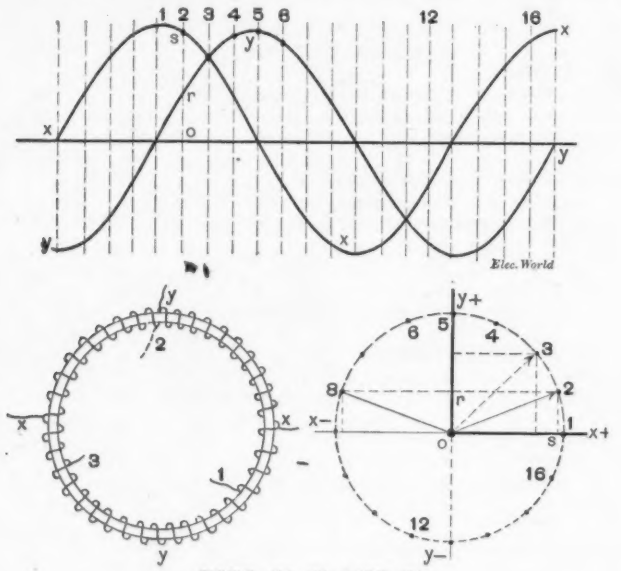
Storage batteries, as a solution of the traction question, are receiving more attention than usual, Americans being probably awakened to their practical use by the examples found in Europe. Of the number quoted, 28 per cent. were issued to foreigners. Of the whole number of patents issued during the year, 9 per cent. were granted to foreign residents.

Laboratory Notes.—XV.

BY LIEUT. F. JARVIS PATTEN.

THE effect of two or more currents acting simultaneously in the same magnetic system, but which change in value constantly with respect to each other, can be plotted graphically and the resulting magnetic effect for a complete cycle determined by a simple graphical method, which for practical purposes is quite as exact as the more general methods of analysis, which for many students would be more difficult, if not entirely beyond their powers.

The method consists in treating the magnetic forces due to the actions of the different currents in a system as so many separate and distinct mechanical forces having a common point of application, and by determining the resultant force



FIGS. 35, 36 AND 37.

of numerous different combinations the loci of the points of these different resultants define a curve which portrays the effect of the different magnetic or current forces at work during a single cycle.

Thus in Fig. 35 we have given two alternating currents, $x\ x$ and $y\ y$. They are in quadrature and have equal maximum values. These must be first plotted as sine curves, if they vary according to the sine of the angle of rotation of the generating armatures, or to get a true result one must know the law of change and lay out the curves accordingly, seeing that the maximum value of one coincides in position with the minimum of the other if the currents are in quadrature, or that any two corresponding values have the proper phase difference. A distance along the axis or time line is then divided into a suitable number of equal parts, 1, 2, 3, etc., to 16, and ordinates are drawn cutting the two curves, and these ordinates may be taken to represent the relative instantaneous values, either of the currents themselves or of their magnetic effect in a system. Consider the latter, and suppose one current acts in the circuit $x\ x$ of the ring winding Fig. 36 and the other acts in the circuit $y\ y$ at right angles to the former vertical and horizontal diameters of the ring. We then lay off two axes of co-ordinates, $X+$, $X-$, and $Y+$, $Y-$, at right angles to each other, and on these we lay off positive values of x to the right and negative values to the left of the centre, or point, of intersection, and positive values of y above and negative values below this point, using the different values indicated by corresponding ordinates of the curves $x\ x$ and $y\ y$ of Fig. 35. The points 1, 2, 3, etc., of the circle, Fig. 37, have been determined in this way.

Thus the point 2 on the circle is determined by laying off on the axis Y the distance $o\ r$ of the curve y above the axis in Fig. 35, and on the axis X the distance $o\ s$ of the curve $x\ x$ above the axis on the same ordinate. Through s and r, Fig. 37, lines drawn parallel to the axis of co-ordinates determine by their intersection the point 2 of the circle, which is the point where a mass free to move would land if actuated simultaneously by two forces, one of which acting alone would carry it from o to r and the other alone would take it from o to s. It makes no difference in effect whether the forces are mechanical or magnetic; in fact, a magnetic force is in many such instances made manifest by a mechanical effect, though not always.

We say, however, that the two currents $x\ x$ and $y\ y$ of Fig. 35 at the instant 2 have a resultant magnetic effect in the system of Fig. 36, which is represented both in its intensity and direction by the line $o2$, Fig. 37.

In like manner at the next instant of time assumed it has the intensity and direction $o3$, Fig. 37, and if we plot this resultant in the manner indicated for all the 16 periods of the cycle we shall obtain the successive 16 points of the circle, Fig. 37, because we shall find that the intensity of the resultant is always the same, its direction only changing by a fixed amount for each successive period of the cycle.

This shows that under the circumstances assumed the magnetic effect is a constant, not a variable, quantity. It only changes in direction, moving once around the circle during each successive cycle. This is what will be referred to as the true rotary field effect, i. e., a constant magnetic pull rotates uniformly around the circle or point of application. This effect will always result from the combination in a single system of two currents acting at right angles to each other and which vary according to the sine law, have equal maximum values, and are in quadrature relation. All the above conditions are essential to the true rotary field effect, and this effect, as will be shown, will be materially altered and disturbed by altering either one or more of the conditions imposed. With them, however, the rotary field is constant in strength and not pulsating, as I have seen stated in the earlier literature of the subject.

If now we rectify the two quadrature currents and superpose the rectified currents in a single circuit, as indicated by the dotted curves in Fig. 38, we should obtain such a pulsat-

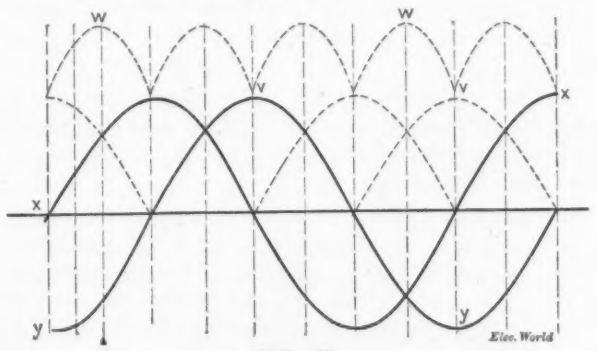


FIG. 38.

ing curve as $w\ w$ for the expression of the result—a curve that has no zero value, to be sure, but which is pulsating in character, and it was formerly quite erroneously assumed that the magnetic field produced by the introduction of biphase currents into a magnetic system would partake of this pulsating effect. This would only be the case, however, if we rectified the currents with the object in view of obtaining from the resulting currents, acting simultaneously, a fixed—not a revolving or rotating—magnetic field.

The rotating magnetic field produced by the undisturbed

action of the biphase alternating currents is constant and uniform.

(To be continued.)

Light and Electricity After Maxwell and Hertz.*

BY H. POINCARE.

At the time that Fresnel's experiments were forcing the scientific world to admit that light is due to the undulations of a very subtle fluid filling interplanetary space, Ampere was making known the laws and mutual actions of electric currents, and advancing the theory that this same fluid, the ether, is the means of electrical actions.

This supposition was strengthened by the unexpected fact that in passing from the system of electrostatic units to the system of electrodynamic units the factor of transformation used is precisely equal to the velocity of light.

But the nature of the relations between optic and electric phenomena was divined by the genius of Maxwell.

According to older writers, conductors permitted the flow of electricity, while dielectrics served only to oppose the flow. But Faraday showed that other conditions being the same in a condenser, the charge was different with different insulators.

If light is an electric phenomenon, then an insulating substance traversed by light must be the seat of this phenomenon; therefore, electric phenomena should be located in the dielectric.

But why are these currents evident under certain conditions, and yet not so under ordinary conditions? Because dielectrics do not simply oppose the flow of electricity with a resistance much greater than that of conductors, but with a resistance like that to be overcome in bending a spring, which increases with the amount of bending until it equals the applied force when movement ends, all the work of bending being restored when the force ceases.

Ordinary resistance is like that met with in displacing a body in water. It depends on the velocity of the body, but not on the total displacement. The movement ends when force ceases, and there is no tendency to restore work done, all being transformed into heat by the viscosity of the water. So conducting wires heat.

Thus, dielectrics have elastic resistance and permit displacement currents, while conductors have viscous resistance and permit conduction currents. Evidently, displacement currents are of short duration, and conductive currents exist as long as the producing electromotive force.

Electrostatic attraction is like the unbending force of the springs, and disruptive discharge like the breaking of some overstrained springs.

When the two poles of a battery are joined by a wire the current is regarded as closed; but when the two poles were joined in the two plates of a condenser the current was regarded as open, traversing the battery and the wires, but stopping on the plates of the condenser. Maxwell, however, supposes a displacement current to continue across the dielectric of the condenser. Thus all currents are closed.

Conduction currents produce heat, affect magnets and currents, and induce currents. Displacement currents do not produce heat, but should show the other effects. We cannot have in dielectrics continuous currents of long duration, nor alternating currents of long period; therefore, their effects are only observed with very rapid alternations.

A luminous wave is a succession of alternating currents produced in the dielectric, which change in direction a quadrillion times per second. The induction due to the high frequency produces other currents in the neighboring parts of the dielectric, and thus the wave is propagated from point to point, the velocity of propagation being equal to the ratio of the units. If there are open currents, these vibrations are longitudinal, like those of sound; but if all currents are closed, electricity acts like Fresnel's incompressible ether, its vibrations being transversal.

The experimental proof of Maxwell's plausible theory was delayed twenty years. Older electrodynamics required electromagnetic induction to be produced instantly; according to the new doctrine it should be propagated with the velocity of light. This latter was established by the interference experiments of Hertz.

Two waves from the same source interfere when they meet at the same point after following different paths. If the difference of the paths is equal to a whole number of wave lengths, the vibrations are in the same phase and add; but if the difference of travel equals an odd number of half-wave lengths, the vibrations are in opposite directions and subtract. Interference is possible with all periodic phenomena propagated with finite velocity. But if the velocity is infinite, there can be no interference.

Imagine two conductors at different potentials united by a wire; a current flows to equalize the potentials, and owing to self-induction (like the inertia of a pendulum at the lowest point of the swing) continues until the conductors take charges opposite to what they had at first. Then the same operation is repeated, and we have an electric pendulum. The period of oscillation decreases with the capacity of the conductors. Al this was made known by Lord Kelvin and Feddersen.

Given the electric pendulum, it is necessary to set it in motion. This requires the disturbing cause to act for a very short time relative to the duration of a period of oscillation. Conditions required these to be one hundred millions to one thousand millions per second; they were produced as follows by Hertz:

Take the electric pendulum and make a cut several millimetres wide through the connecting wire, separating the apparatus into two symmetrical halves, which are joined to the two poles of a Ruhmhorff coil. When a certain difference of potential is produced a discharge occurs across the air gap affording a path for the oscillations of the conductors. Under certain rather complex conditions studied by Hertz, suitable oscillations are produced. These very rapid oscillations of the exciter are detected by a resonator, which consists of two small spheres joined by a wire bent into a circle so as to bring the spheres very close together.

The induction due to the exciter puts the resonator in vibration the more readily when their periods are about equal. At certain phases of the vibration the difference of potential of the two spheres is great enough to cause sparking across the gap.

We may expose the resonator to the direct induction of the exciter at a great distance, reflection being produced by a mutual sheet as by a mirror; or we may let the exciter act at a short distance on a long wire, which the electric waves follow, and which will act at a short distance on the resonator, the reflexion being produced at the end of the wire. In either case the reflected wave interferes with the direct wave, and points are found where the sparks of the resonator are extinguished. These experiments show that the velocity of propagation of induction across air is finite, and that it is equal to the velocity of the wave along the wire, in confirmation of Maxwell.

In conclusion, the results acquired are these: The velocity of induction through air is finite, without which interference would be impossible. The length of the wave can be measured. The velocity of the wave along a rim has been measured directly by Blondlot and found to be equal to the ratio of the units.

* Abstract of an article in "L'Annuaire du Bureau des Longitudes pour 1894."

Rope Driving.—VII.

BY J. J. FLATHER.

ROPES made of the same hemp and the same weight per foot, but twisted respectively to two-thirds, three-fourths and four-fifths of the lengths of their component yarns, supported the following weights in two experiments made by Duhamel:*

	Pounds.	Pounds.
Two-thirds	4,098	4,250
Three-fourths	4,850	6,753
Four-fifths	6,205	7,397

The results of these experiments led Duhamel to make ropes without twist by placing the yarns together and wrapping them round to keep them together. The rope had great strength and pliability, but not much durability on account of the outer covering wearing away or opening when bent, thus admitting moisture to the interior, which rotted the yarns.

In general, the greater the twist the more hard and rigid the rope is, and the better it will keep its form; but it is not as strong nor as pliable, weight for weight, as the more loosely twisted rope; for this reason the latter is to be preferred for transmission purposes.

A very excellent transmission rope, known as the "Lambeth," is made in a somewhat similar manner to that just described, but it is not open to the same objections. In this case the rope, which is of cotton, is made of four strands twisted together in the usual manner, but the strands are themselves composed of a bundle of fine yarns and have scarcely an appreciable twist. Each bundle, comprising many hundred yarns, is wound spirally with smaller bundles of about 100 yarns each.

In this way the outside of the rope acts as a shield or covering to the cores which do the work. By this means a certain amount of the natural elasticity of the rope is retained, and its pliability is much greater than in ordinary hawser laid ropes.

Lubrication of ropes is provided for in various ways. Frequently the rope is laid up dry and a coating or dressing is given to the exterior, which is supposed to penetrate to the interior and lubricate the fibres. With some dressings this may occur, but with others the effect is merely local; the interior of the rope remains dry, and much bending soon wears it out. With cotton ropes, as we have already noted, the internal chafing and wear is very much reduced, and for this reason cotton ropes are laid up dry and are not usually lubricated; they are, however, generally coated with some form of dressing to prevent the fibre from rising or the rope fraying, and to protect it from moisture when exposed to the weather. According to the nature of the dressing, the interior may or may not be affected by the outer coating. Beeswax and black lead, with a little tallow, forms an excellent moisture proof covering for ropes; it fills in the spaces between the strands, and the rope soon assumes a perfectly round and smooth appearance, like a bar of iron; with this coating the interior remains dry and should therefore not be used where a lubricant is desired. Pine tar is much used on cotton ropes for the same purpose. Mixtures of tallow and black lead; molasses and black lead; equal parts of resin or beeswax, with black lead, tallow and molasses melted together, and applied hot; and various other compounds are in use for this purpose. Tallow, lard and other greases are used separately and are fairly satisfactory as a lubricant. When the rope runs out of doors a waterproof coating is necessary to preserve it from decay, and for this purpose, if it is also desired to lubricate the rope at the same time, there is probably nothing better than tallow and black lead, or graphite, provided the rope is not twisted too hard, which would prevent the dope from penetrating. In certain drives that are subjected to hard service and are more or less exposed to the weather, boiled linseed oil is used very successfully. According to Mr. A. D. Pentz, the rope is treated every two weeks to about two quarts of the oil, dripped one drop at a time upon one of the sheaves, which is uncovered on top; the rope runs on the bottom of the sheave and slowly absorbs the oil. Although the rope is very materially weakened by this process, yet the greater freedom of the fibres permits a heavier working strain to be carried, for it is the relative wear of the fibres that determines the life of the rope. A manilla rope with the fibres properly lubricated will, under the same conditions, outlast from two to four similar dry-laid ropes which are allowed to run dry. Manilla transmission ropes are generally laid up in tallow, paraffine, soapstone, or a mixture similar to the above preparations.

A superior manilla transmission rope is that known as the "Stevedore," or black rope, which is made with both three and four strands, the latter being laid up about a central core. The yarns of this rope are each coated with a mixture of graphite and tallow, so that when twisted up into strands the coating lodges in the hollows and uneven places among the fibres, and thoroughly lubricates the strands and individual fibres composing the rope, which is thus made practically waterproof; after it has been in use a short time its appearance is that of a black rod of iron, smooth and round, similar to the beeswax-coated rope previously mentioned, but perfectly flexible. A manilla rope thus made will last from three to eight years if not overstrained; when running indoors under favorable conditions the latter limit may be attained, but when exposed to the weather, or when working under less favorable conditions, its life will be shortened.

Hemp ropes intended for outdoor service are sometimes treated by passing the yarns through boiling hot tar, suitable machinery being used to regulate the amount of tar retained in the yarns so that the fibres may be coated over and thus preserved from decay. Tarring protects rope from injury by exposure to rain and immersion in water; but it makes its fibre rigid and impairs its strength; for this reason it is unsuitable for ordinary transmission purposes.

It has been shown by experiment:*

1. That white or untarred rope in continual service is one-third more durable than tarred. 2. That it retains its strength much longer when kept in stock. 3. That it resists the ordinary injuries of the weather one-fourth longer. With the exception of the outside yarns of large hawsers, manilla ropes are not tarred.

The breaking strength of a rope will depend both upon the quality of the material and the degree of twist given to the strands; for a loosely twisted rope of a given diameter the strength will be less than that in a hard twist of the same diameter, but compared weight for weight, the rope with the lesser degree of twist is the stronger.

As the hard-twisted rope is more rigid than the loosely twisted, it is not as suitable for transmission purposes, owing to the rapid wear which constant flexure produces.

In discussing the strength of ropes, which formerly was always given in terms of the circumference, there is a lack of uniformity among writers in the relation between the diameter and area of a rope. The circumference, as measured by a tape, depends upon the number of strands in the rope and their compression upon one another. If the strands still retained their circular section when twisted into a rope, the circumference of a 3-strand rope would be 2.86 times the diameter of the circumscribing circle, as given by Nystrom; if the strands completely fitted the circle its meas-

* Tomlinson. Vol. VII., p. 574.

* Capt. S. B. Luce, U. S. N.

ure would be π times the diameter as given by Unwin and others.

As neither of these conditions obtain in practice the true value lies between 2.86 and 3.14, and we shall assume 3 as the most suitable factor.

In the same way the area of the cross-section of the rope is variously estimated as that of the area of the circular strands, or as the area of the full diameter of the rope.

By assuming the rope to be made of three strands, the cross-section of each of which is a circle, the area of the rope would evidently be $3\left(\frac{\pi}{4}\delta^2\right)$ where δ is the diameter of each strand. If d represents the diameter of rope, i. e., the diameter of circumscribing circle, the area in terms of d will become:

$$A = 3\left(\frac{\pi}{4}\delta^2\right) = \frac{\pi\, d^2}{6.16} = 0.52\ d^2.$$

The section of the strands, taken at right angles to the axis of the rope, is, however, not a circle, as can be seen from Fig. 27. The degree of twist given to the strands, and the compression of the latter upon one another, will evidently affect the area of the section; for the longer the spiral the more nearly will the cross-section of each strand approach a circle. It is obvious that the true value must lie between $0.52\ d^2$ and $0.7854\ d^2$. In determining this area the writer made a number of plaster casts at different points of six 3-strand manilla ropes, varying in size from 3-4 inch to 1 3-4 inches diameter. With these casts as dies, which were covered with printer's ink, impressions were made and the area obtained by using a planimeter. The area at several sections of each rope was found to be practically constant and varied between $0.61\ d^2$ and $0.65\ d^2$—the mean value being $0.63\ d^2$, from which we obtain the ratio:

$$\frac{\text{Area of section of rope}}{\text{Area of circumscribing circle}} = \frac{0.636\ d^2}{0.7854\ d^2} = 0.81;$$

that is, the actual area of a 3-strand rope equals 8-10 of the area of the circumscribing circle.

(To be continued.)

Moonlight Tables for March, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of March under his modified form of moonlight schedule.

TABLE NO. 1.
Standard Moonlight.
Philadelphia System.

Date.	Light.	Date.	Exting.
1	6.20 P. M.	2	5.00 A. M.
2	6.20 "	3	5.30 "
3	6.20 "	4	5.30 "
4	6.20 "	5	5.30 "
5	6.30 "	6	5.30 "
6	6.30 "	7	5.20 "
7	6.30 "	8	5.20 "
8	6.30 "	9	5.20 "
9	6.30 "	10	5.20 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	11.00 "	13	5.20 "
13			
14	12.10 A. M.	14	5.10 A. M.
15	1.20 "	15	5.10 "
16	2.20 "	16	5.10 "
17	3.10 "	17	5.10 "
18	3.50 "	18	5.10 "
19	No Light.	19	No Light.
20	"	20	"
21	"	21	"
22	6.40 P. M.	22	8.40 P. M.
23	6.40 "	23	9.50 "
24	6.50 "	24	11.00 "
25	6.50 "	25	12.00 "
26	6.50 "	27	1.00 A. M.
27	6.50 "	28	2.00 "
28	6.50 "	29	3.00 "
29	6.50 "	30	3.40 "
30	6.50 "	31	4.20 "
31	6.50 "	1	4.40 "

Total hours, 206.30.

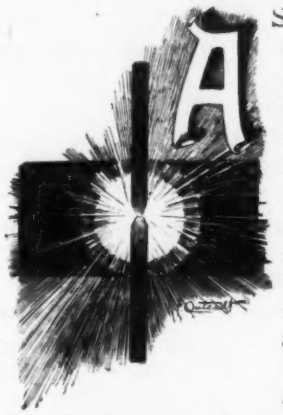
TABLE NO. 2.
Frund's New Moonlight
System.

Date.	Light.	Date.	Exting.
1	6.20 P. M.	2	5.00 A.M.
2	6.20 "	3	5.30 "
3	6.20 "	4	5.30 "
4	6.20 "	5	5.30 "
5	6.30 "	6	5.30 "
6	6.30 "	7	5.20 "
7	6.30 "	8	5.20 "
8	6.30 "	9	5.20 "
9	6.30 "	10	5.20 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	6.30 "	13	5.20 "
13	6.30 "	13	12 M.
14	12.10 A. M.	14	5.10 A. M.
14	6.40 P. M.	14	12 M.
15	1.20 A. M.	15	5.10 A. M.
15	6.40 P. M.	15	12 M.
16	2.20 A. M.	16	5.10 A. M
16	6.40 P. M.	16	12 M.
17	3.10 A. M.	17	5.10 A. M.
17	6.40 P. M.	17	12 M.
18	3.50 A. M.	18	5.10 A. M.
18	6.40 P. M.	18	12 M.
19	6.40 "	19	12 "
20	6.40 "	20	12 "
21	6.40 "	21	12 "
22	6.40 "	22	12 "
23	6.40 "	23	12 "
24	6.50 "	24	12 "
26	6.50 "	27	1.00 A. M.
27	6.50 "	28	2.00 "
28	6.50 "	29	3.00 "
29	6.50 "	30	3.40 "
30	6.50 "	31	4.20 "
31	6.50 "	1	4.40 "

Total hours, 260.66.

The Theory and Design of the Closed-Coil, Constant-Current Dynamo.—II.

BY HENRY S. CARHART.



ASSUMING still practically constant speed, we next inquire into the methods employed to maintain a constant current without appreciable sparking by rocking the brushes round the commutator cylinder.

In one machine the brushes are moved automatically by means of a small electric motor and at the same time field coils are successively cut out as the brushes rock forward with a light load. A pair of brushes is used on each side and they are kept at a fixed distance apart. By these combined means the machine can be run on short circuit with the normal current and without sparking.

Another system leaves the field coils constantly in circuit, but employs two pairs of brushes and varies the angular distance between the members of each pair when the brushes are moved. The movement of the brushes is effected mechanically in response to any change in the main current till the current is brought back to the normal value. In these machines the spread of each pair of brushes, or what is sometimes called the overlap of the brushes, is lessened as they rock forward toward the polar centres. Very satisfactory results are secured in this way.

In the third class of machines only one pair of brushes is used, which lap over about two or three commutator sections, and the regulation of the current is effected solely by the movement of this one pair without change of overlap and without disturbance of the ampere turns on the field. The brushes are moved mechanically by means of an automatic regulating device. No less satisfactory results appear to be secured by this method than by the others, while the mechanism as a whole is somewhat simpler.

I have described these three methods for the purpose of pointing out their bearing on the theory and design of closed-coil Gramme rings for constant currents. The important question is not how to get the necessary E. M. F. with such a dynamo, but how to vary that E. M. F. in response to the varying demands of the external circuit, without injurious sparking at the brushes.

The E. M. F. is controlled in all three of these methods by rocking the brushes, and the other differences in the devices are made necessary for the suppression of the sparking. This brings us to a consideration of the most intrinsically interesting topic of the paper, viz., the conditions necessary to suppress sparking and the features of design required to furnish them.

If we assume that the armature is well balanced electrically and magnetically and that the brushes have a proper bearing in contact with a smooth commutator, the conditions required to commute the current without sparking are known to be as follows: With a two-pole dynamo, the current is divided through the armature, one-half going from brush to brush through one side and the other half through the other side. Hence, when an armature coil is carried past the brush it is transferred from the one circuit through the armature to the other, and at the same time the current through it reverses its direction. This constitutes the act of commutation. But the sudden decay of a current through a coil in one direction and its growth to an equal value in the other gives rise to an E. M. F. of self-induction opposing the change. This E. M. F. will prolong the flow of the current on one side of the brush and will oppose its rise on the other side. Hence, if the coil is short circuited by the brush

lapping over the two consecutive commutator segments to which its ends are connected, even when the coil passes the neutral plane of the dynamo, the E. M. F. of self-induction produces a local current through this coil; and when the one end of the coil slips past the brush and becomes a part of the other half of the divided circuit, the current which should reverse through it meets the opposing current and breaks over the gap to the brush with a spark. Hence the commutation must not take place at the neutral plane, but in advance of it, and in a field where the induced E. M. F. in the coil shall be just sufficient to offset the self-induction, and in addition reverse the current in the coil while it is passing through the brush or pair of brushes, and cause it to grow to the normal value at the instant when one end of it passes out from under the brush. The induction from the field must be sufficient to bring the one current to zero and to set an opposite one of equal value flowing in the coil during the time it is under the brush. Then the commutation will be sparkless.

Now if the current is kept constant in strength the field induction required to accomplish the results described is approximately the same whether the coil is short circuited at one angle or another in advance of the neutral plane. It would appear at first thought that, unless the induction in every part of the field from the neutral plane to a point nearly 90 degrees in advance of it is substantially uniform, terrific sparking must result when the brushes are shifted far forward to vary the electric pressure to suit the requirements of the circuit; for if the induction is in excess of the requirements to accomplish the result described in the commuted coil, then the current will circulate through it during the short circuit, and the rupture of this on leaving the brush will cause sparking. I have illustrated this action in the following manner: Separately excite the field magnets of a machine, which can run on short circuit even, with a forward displacement of the brushes without sparking. Then leaving the armature on open circuit, rock the brushes forward; the sparking will increase with each advance till it becomes terrific and endangers the machine. The induction to which each coil is subjected in an excited field produces a large current in it while it is under the brush, since there is less self-induction in the coil to offset the induction from the field than there is when the machine is self-excited and working in the normal way. There is another reason to be described later.

Considerations of this kind have led some writers to say that sparkless commutation for any position of the brushes can be accomplished only when the induction in the field is made uniform. The Statter constant-current machine in England is made on this principle. Portions of the pole pieces are laboriously cut away at such points as to make the density of the lines of force entering the armature over a given angle equal. Of course, a machine built in this way will permit of shifting the brushes through a considerable angle, in order to vary the potential difference without introducing sparking. But while a uniform field accomplishes the result, no such uniformity is required; the same result may be secured in other ways. The first method, already described, weakens the field when the brushes move forward by cutting out ampere turns in the field magnet. This reduces the induction to the proper amount at each point without changing the overlap of the brushes. It is made necessary by the very high saturation of the armature core in this machine. It has the advantage of greater economy with small loads, because field resistance is cut out, but it requires a more complex arrangement of parts on the machine than suffices for the mere movement of the brushes.

The second method diminishes the overlap of the brushes as they are rocked forward. In the first place, this has the effect of diminishing the time allowed for the reversal of the current, but it also diminishes the number of turns of wire in the coil or coils included between the two parts of each brush. The curtailed time interval increases the self-induction of each convolution of wire, because it increases the rate of change of the current in the coil undergoing commutation; but this increase is counterbalanced by the diminution in the number of turns of wire short circuited by the brush. Hence, the total self-induction during commutation remains not far from constant. When the brushes shift forward into a denser field, however, the diminution in the overlap decreases the number of turns of wire included between the pair of brushes composing either the positive or the negative, and so cuts down the total field induction in those coils during commutation to the amount required to suppress sparking. The overlap of the brushes must therefore be inversely as the induction in a coil under the brush in different parts of the field, for the presence of the pole of the armature at any point reduces the induction. This point is a complicated one and needs further experimental study.

But in the third class of machines the overlap of the brush is constant and the field is not weakened by cutting out coils on small load. Neither are the pole faces cut away to produce uniform induction. Attention is given to the thickness of the pole pieces, so as to avoid unnecessary crowding of the lines of force toward the central portions. It is also desirable to avoid thinning of the polar horns, lest they become saturated. In the old Sperry machine, which I have investigated quite carefully, each pole piece is cut quite in two. In fact, as is well known, the field has four cores. At the same time the horns, or pole tips, are rather blunt. But this machine shows the violent sparking when separately excited, with the brushes far forward and the circuit through the armature open. The induction round the armature is not uniform, but the sparking is small for any position of the brushes with the normal current. The brush bears on about three commutator segments. I refer to this machine as an illustration of the class and not as a model of excellence. It is no longer built.

In this machine the induction to which a coil is subjected near the brush is not the same in different parts of the field, but diminishes as the brushes are worked forward, the current being kept constant. With the exploring coil before described and the two extra brushes bearing on the insulated copper ring and the fibre collar with brass segment, respectively, the external circuit connecting the two small brushes was carried through a d'Arsonval galvanometer in shunt. The two extra brushes were attached to the two main brush holders, but were insulated therefrom. With one brush making contact with the small brass segment, two and then three commutator bars in advance of the upper main brush, the following deflections were obtained with the galvanometer from maximum to minimum load, the steps being about equal:

Deflection, 2 segments.	Deflection, 3 segments.
26	63.5
24	56
22	49
20	41
18	34
16.5	32
13 5	28
12.5	
10.5	

The steps were not the same in the two series of observations. No trouble was found in obtaining a steady deflection of the galvanometer, the dynamo making about 1,200 revolutions per minute. The exploring coil was therefore subject to a diminishing induction near the brush, as it moved forward with the brush toward the centre of the polar surface.

(To be continued.)

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

ELECTRO-PHYSICS.

Thermo-Electric Phenomena.—"Electricity," Jan. 12, quotes from a paper by Mr. Steele from "Science," describing briefly some of his researches in the generation of electromotive force by the heating of a single metal; the highest effect observed was with gold, in which he obtained nearly half a volt for a short length (presumably a few inches); a clay tube (tobacco pipe stem), containing lead, gave 0.3 volt; in general the E. M. F. was unsteady and irregular.

Aurora Borealis.—It is suggested in "La Lum. Elec.," Jan. 6, that the following experiment by Mr. Rimington may lead to an explanation of the phenomena; he found that a vacuum tube becomes illuminated if rotated while near a rod of rubber or sealing wax which has been electrified.

Atmospheric Electricity.—The Lond. "Elec.," Jan. 12, describes briefly, though not very clearly, the apparatus used by Mr. Andre for measuring the difference of potential of the atmospheric electricity by means of a balloon; the results of these tests were mentioned in the Digest Jan. 2.

Dynamical Theory of the Electric and Luminiferous Medium.—The article by Mr. Larmor, mentioned in the Digest last week, is concluded in the Lond. "Elec. Rev.," Jan. 12.

Dielectric Constants of Biaxial Crystals.—"La Lum. Elec.," Jan. 6, reprints at some length an extract from a thesis by Mr. Borel on this subject.

MAGNETISM.

The Pull of Magnets.—The serial in "Ind. and Iron" is continued in the issue of Jan. 12; the law that the pull of a magnet on its armature varies as the square of the induction and the area is stated and its application to telephones and measuring instruments is discussed; if the area of the poles of an electromagnet be halved, the total induction remaining the same, the force per square centimetre will be quadrupled, but as the area is halved the force on the armature will be doubled; with a given induction, therefore, it follows that the force varies inversely as the area; the pull of a magnet may therefore be increased by tapering the pole pieces down, provided the total induction is not diminished thereby; such polar surfaces could be cut up into a number of small poles, separated by shallow grooves; this method should be adopted in magnetic brakes, magnetic friction clutches and similar machinery. As very minute inaccuracies in the faces of a magnet and its armature make very great differences in the force, it is not possible to make accurate measurements of the induction in iron by means of the pull.

Transformation Produced in Iron by a Strain.—A translation of Mr. Charpy's article, mentioned in the Digest last week, is given in abstract in the Lond. "Elec.," Jan. 12.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Kruppin, a New Resistance Metal.—The "Elek. Zeit,," Jan. 11, contains additional information about this material, which was described in the Digest Jan. 6. Results of a series of elaborate tests made by the Imperial Institute are given; prior to the tests the metal was heated for two hours to 200 degrees C., and the measurements were made at 150 degrees, 100 degrees, 50 degrees and normal temperature; the results are as follows: Specific gravity, 8.102; tensile strain, 60 kilogrammes per square millimetre; elongation, 22 to 25 per cent.; specific resistance, 85.13 microhms per centimetre per square centimetre at 20 degrees C.; mean temperature coefficient 0.0007007. The resistance is quite appreciably higher than that of the usual resistance metals and only 10 per cent. less than that of mercury; it can be kept at a temperature of 600 degrees C. without suffering any change in its structure, while for other metals a much lower temperature is sufficient to make them brittle; it is specially adapted to starting resistances for motors, regulating resistances, etc.

Phase Meter.—Referring to the apparatus of Prof. Puluj, mentioned in the Digest Dec. 23, the Lond. "Elec. Rev.," Jan. 12, states that a similar method was tried by Mr. Rollo Appleyard some six months ago, but it was found to be quite impracticable, owing to the vibration of the spring, but Prof. Puluj claims to have met this by a preliminary tuning of the spring; it suggests that a twisted strip with a single half-turn might possibly replace the two springs, in which case only one mirror would be required.

Price Indicating Meter.—The "Elek. Rundschau," No. 7, describes and illustrates an instrument resembling an amperemeter, the reading of which at any moment indicates the cost of the current which is being consumed at that moment.

Thallium.—The following data are given in a paper by Mr. Steele mentioned in the Lond. "Elec.," Jan. 12. Specific electrical resistance, 20,200 C. G. S. units at 20 degrees C., with a coefficiency of variation of resistance 0.00392, in the neighborhood of this temperature; "the absolute thermo-electric height of thallium is $216 - 0.79\,T$, where T is the temperature on the centigrade scale.

Influence of Deformation on Resistance.—"La Lum. Elec.," Jan. 6, reprints an abstract of a Royal Society paper by Messrs. Gray and Henderson.

DYNAMOS AND MOTORS.

A New Method of Coupling Motors.—Mr. Guilbert in "La Lum. Elec.," Jan. 6, describes a new method for coupling two non-synchronous multiphase motors, so as to obtain variable speeds, devised by Mr. Siemens and called the cascade coupling. The field of the first motor is connected directly to the mains; the three armature circuits, supposing it to be a three-phase motor, are united in common at one of their ends, the other ends leading through contact rings and brushes to the field of a second similar motor, whose field connections are identical with the armature connections of the first; the armature circuit of this second motor is closed through adjustable resistances and has no connection with any other circuit; thus the induced currents in the armature of the first motor supply the field currents for the second motor, the armature currents of which are induced by the field currents. At starting the frequency in the second motor is equal to that in the first, but as the speed increases the frequency diminishes until the sum of the revolutions is theoretically equal to the revolving field in the first motor;

they will regulate to run at a speed equal to a few per cent. below half that of synchronism. For variable speeds the two movable parts of the motors are keyed to a common shaft, and they are connected in cascade or in parallel, according as the speed is to be ordinary or half speed; when so coupled, it is best to connect the armature of the first and the field of the second to a common shaft, as this avoids sliding contacts. The efficiency is said to be the same for all the speeds; for 1-3 of the synchronous speed three motors are thus coupled. When not coupled mechanically the two motors may be made to have speeds relatively different. The article contains a good illustration of the connections.

Improvements in Dynamos.—An illustration is given in "La Lum. Elec.," Jan. 6, of the curious modification of the field used by Mr. Dobrowolsky, consisting of uniting the horns of the pole pieces by a yoke piece of iron, thus connecting them magnetically and forming a magnetic shunt or strong leakage around the armature; the intention is to diminish the sparking at the brushes and the losses due to Foucault currents; the change of magnetic polarity at the neutral line is thus made less sudden; the waste of magnetism is doubtless of small consequence in comparison to the advantages gained, especially as the field current itself is but a small fraction of the output of the dynamo.

Dynamos.—"La Lum. Elec.," Jan. 6, begins another instalment of the well illustrated article by Mr. Richard, in which 66 illustrations of various recent improvements in dynamos are given, taken presumably from patent specifications.

Irregularities in the Action of Dynamos.—The serial on this subject is continued in "L'Elec.," Jan. 6. A translation of the portion referred to last week is given in the Lond. "Elec. Eng.," Jan. 12, including several illustrations.

Cranes.—The article on this subject, mentioned in the Digest last week, is concluded in the Lond. "Elec. Eng.," Jan. 12, in which well-illustrated descriptions of several different cranes are given, some of which are of American make.

ARC AND INCANDESCENT LIGHTS.

Projectors.—In "L'Elec.," Jan. 6, Mr. Sciama describes a new projector made by Breguet, which, like those of Schuckert, have a parabolic mirror; in comparing these with the Mangin reflectors he states that the focal distance is much less, being for a reflector of 900 millimetres equal to 680 millimetres for the Mangin and 340 millimetres for the parabolic mirror; they are also much lighter, having only about half the weight for the complete apparatus; an arrangement is described for operating them from a distance by means of two electric motors.

Blackening of Lamp Bulbs.—The Lond. "Elec. Rev.," Jan. 12, contains a short editorial on this subject, without, however, giving anything new.

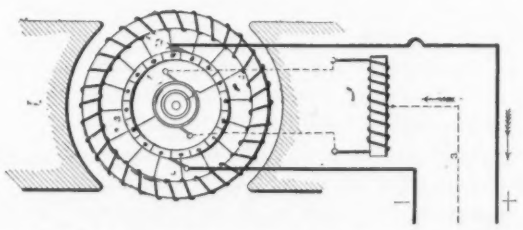
ELECTRIC RAILWAYS.

Electric Traction.—Mr. Epstein's article, abstracted last week, is concluded in the Lond. "Elec. Rev.," Jan. 12. Regarding the cost of fuel, he states that for fairly representative conditions 80 watt hours are required to be put into the motors per ton mile propelled for the trolley and conduit systems, which, after allowing for the various losses, corresponds to .24 indicated h. p. hour; for eight tons per loaded car this corresponds to 1.92 h. p. hours, and at a consumption of three pounds of good coal per indicated h. p. hour at $5 per ton the price of fuel per car mile will be 1.234 cents; with accumulator cars the engines and dynamos will be worked at a more uniform rate, and therefore have a higher combined efficiency, and the corresponding figures will then be .177 indicated h. p. per ton mile propelled, which for ten tons per car costs 1.14 cents for coal per car mile; notwithstanding the greater weight, the consumption of fuel is less; he believes that American practice would show that owing to the great waste in the trolley systems, the comparison is much too favorable for the direct systems. He gives two large tables of details for the cost of converting an existing horse railway into each of the three electrical systems, the conditions being the same as those mentioned last week; for insulated wire feeders, and assuming that the existing permanent way may be used, his estimates for five minutes' headway and 24 cars are about $35,000 for the trolley, $50,000 for the conduit and $23,700 for the accumulator system, all three being the cost per car per mile of double track. The results are summarized in another table. Another table contains detailed data of a number of tests on the Birmingham road; another table gives the estimated costs of working the three different systems, the average being about the same for all, namely, about 19.2 cents, which is due to the fact that the interest on the capital is less in favor of the accumulator system. In conclusion, he summarizes the results, showing that the cost of the installation for an accumulator line is less than for either of the others and represents a saving of about 20 per cent.; this is still more favorable in the construction of an existing tramway, in which case the outlay is about one-half of that for the trolley and one-third of that for the conduit; in conclusion, he summarized some of the most important advantages in favor of accumulator roads, all of which are already well known.

Electric Traction.—The Lond. "Elec. Rev.," Jan. 12, states that Mr. Rankin Kennedy has discovered a new method of electric traction, by which the great drawback to the present system is said to be overcome; the 25 to 40 h. p. motors will be replaced by motors of 5 to 10 h. p.; this method, it states, is being submitted to American experts.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Three-Wire System.—"La Lum. Elec.," Jan. 6, describes and illustrates a modification used in France devised by Mr. Dobrowolsky which enables a single dynamo to be used for a three-wire system. The arrangement is shown in the accompanying illustration; the modification of the dynamo



THREE-WIRE SYSTEM WITH SINGLE DYNAMO.

consists in connecting two diametrically opposite points of a Gramme winding together through a good self-induction coil to the middle point of which coil the neutral wire is attached; when this induction coil can be attached to the armature itself the single connection may be led out through the shaft; but if there is no room, the arrangement shown in the figure is used, which requires two sliding contacts; the induction coil must have very great self-induction and low ohmic resistance; the alternating E. M. F. at the terminals of the induction coils prevents all but a small current from passing; the difference of potential between the ends and the middle is the same; an excess of current, which returns through the neutral wire, passes back to the armature through the two halves of the coil, the ohmic resistance of which does not oppose the passage of a continuous current. The same arrangement can be used as a regulator for a three-wire system, and if placed at sub-stations it avoids the necessity of leading the neutral wire back to the station.

Solar Motors.—In "L'Elec.," Jan. 6, a motor proposed by Mr. Ayme, of Algiers, is described and illustrated, in

which the heat of the atmosphere is to be used; it consists of a large flat iron tank, painted black, about 65 feet long, 25 feet wide and 1 1-2 feet deep, filled with water and exposed to the rays of the sun; it is connected with a cylinder 6 1-2 feet long and about 1 1-2 feet in diameter, containing a piston, on which the pressure developed will be about 110 pounds per square inch; for a rise of 20 degrees C., which takes place between sunrise and noon, the number of calories generated will be 1,540,000, of which he thinks about half can be utilized, thus generating about 75 kilowatts during six hours; owing to the very slow motion of the piston, about one-fourth of an inch per minute, and to the great speed of the dynamo, a long train of gears is required; in case of rain the receptacle is heated by means of petroleum residues; in very cold climates the water must be mixed with salt to prevent it from freezing. (It appears to be only a proposition.)

Rotary-Phase System.—The "Elek. Rundschau," No. 7, publishes a conclusion of the mathematical article on the three-phase system.

Flush Snap Switch.—"La Lum. Elec.," Jan. 6, describes and illustrates a switch of Messrs. Gartside and Wood.

Rectifiers.—The Lond. "Elec. Rev.," Jan. 12, contains an article by Mr. Kennedy, giving, however, nothing new.

Wakefield.—The Lond. "Elec. Rev.," Jan. 12, publishes a report by Mr. Hammond for the proposed lighting of this city, containing comparative tables and data. A much more complete extract is given in the Lond. "Elec Eng.," Jan. 12.

Liverpool.—The London "Electric Plant," Jan. 1, publishes a double-page plate of an interior view of the Liverpool central station.

WIRES, WIRING AND CONDUITS.

Explosions in Electric Conduits.—An editorial on this subject in the Lond. "Elec. Rev.," Jan. 12, states that in the Glasgow conduits there were four serious explosions within six weeks; it discusses the subject, stating emphatically that the infiltration of gases from the soil is altogether inadequate to account for the presence of the gas; it believes the influx of gas is more probably due to the subsiding of the soil below the conduits and their consequent pressure on gas pipes beneath them, which causes ruptures of the pipes. It also advocates the electrical connection between the sections of the culverts in order that they form one large earth plate; another mistake was the dragging of the wires through cast iron pipes without properly protecting them. (That the infiltration of gases might be quite adequate, at least in the streets of New York, would appear from a statement recently made by an employe who has spent many years in laying such conduits; he stated that almost anywhere in New York one could make a hole in the street with a crowbar and explode the gases which collected by igniting them with a match.)

A correspondent of the Lond. "Elec. Eng.," Jan. 12, proposes as a remedy the introduction of escape pipes at every manhole and at intervals between them, laid underground up to the house wall and then up the fronts of the buildings to above the roof, where they are suitably capped to prevent the rain from entering; at the bottom of these pipes traps might be placed to collect and carry away any water that might be deposited by the gas.

Insulation Resistance for House Wiring.—The Lond. "Elec.," Jan. 12, compiles in the form of a diagram the rules of a number of companies and institutions in England reduced to a common standard of measurement; they follow more or less closely the logarithmic law, $R = k \div n$, in which R is the insulation resistance, n the number of lamps wired (presumably 8-c. p. lamps of one-third of an ampere) and k a constant which ranges from 130 down to 0.6 megohms per lamp; for 60 lights, which is considered a good average number, the resistance in megohms is given according to the rules of the various companies, and it varies from 2.0 to 0.21, the higher ones being, as a rule, in London, and the lower ones in the smaller cities.

Resistances with Alternating Currents.—A translation of the article abstracted in the Digest Jan. 20 is given in the Lond. "Elec.," Jan. 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Protective Device Against Strong Currents.—The "Elek. Zeit.," Jan. 11, publishes an illustrated description by Dr. Passavant of his apparatus for protecting telegraphic, telephonic and other like apparatus against strong currents; it consists essentially of a small relay, which, when the current increases, closes a short circuit through a fusible wire, which then melts and breaks the circuit; a diagram of the arrangement is given. In a discussion Dr. Strecker remarked that the price, 50 cents, was still too great to permit its introduction on a large scale; he claims that such an apparatus should not cost more than 5 to 8 cents. Dr. Feussner described another apparatus, in which a horizontal wire through which the current passes has a weight attached to its middle point by means of an easily fusible hook, such as one made of shellac; the weight at the same time holds a contact closed; when the current increases to over 0.1 ampere the heat is sufficient to melt the hook; the release of the weight then opens the contact.

Mercury Contacts in the Wheatstone Rapid System.—"La Lum. Elec.," Jan. 6, describes and illustrates a device of Messrs. Price and Gray, intended to overcome the principal faults of the present Wheatstone rapid system, in which a perforated band is used; the contacts are made by means of jets of mercury, which are kept flowing continuously; at the receiver end the relay operates a small contact point, which makes or breaks contact with a continuous stream of mercury flowing horizontally directly above the contact point.

Autographic Telegraphy.—"La Lum. Elec.," Jan. 6, describes the Sheehy system, in which drawings or writing on a sheet of paper are transmitted to a distance, where a facsimile is reproduced; there is a revolving drum in each apparatus, over which a contact point moves, the two drums being revolved synchronously; it appears to require but one line wire.

Electric Winding Apparatus.—"La Lum. Elec.," Jan. 6, contains an illustrated description by Mr. Marcillac of an apparatus for rewinding, by means of a motor, the train of weights and gears used in the Hughes apparatus; the motor is controlled by a simple lever arrangement.

Working Speed of Cables.—The Lond. "Elec. Rev.," Jan. 12, states that the favorite idea of substituting an induction coil repeater for the mechanical apparatus has been tried, and the results show conclusively that no gain in speed whatever is obtained; an induction coil repeater on a telephone line produced a marked deterioration in the speaking.

Theatrophone.—"L'Elec.," Jan. 6, announces that the installation of the theatrophone at Bordeaux is completed; any subscriber of the municipal telephone system can now be connected with many of the theatres.

Telephone Statistics.—The Lond. "Elec.," Jan. 12, contains a large table compiled from the "Jour. Telegraphique," giving the statistics for 1892 for all the civilized countries (except the United States). The same number contains an editorial on this subject.

Swedish Telephone Statistics.—The "Elek. Zeit.," Jan. 11, gives a summary of the statistics for the year 1892, including some comparative figures for a number of years previous.

Central Telephone Station in Paris.—A translation of the article mentioned in the Digest Jan. 6 and 13 is given in abstract in the Lond. "Elec.," Jan. 12.

Water and Gas Pressure Indicator.—The "Elek. Zeit.," Jan. 11, gives a well-illustrated description of a new apparatus of Siemens & Halske for automatically indicating at a distance the readings of an indicator of the water level in a basin or the gas pressure in a reservoir.

ELECTRO-CHEMISTRY.

Action of Electrolyzed Sea Water on Iron and Lead Pipes.—"Ind. and Iron," Jan. 12, states that at Havre three months' experience has shown that lead pipes may be employed to distribute this fluid; in lead pipes a film of scale forms similar to that of lead peroxide, and with iron the film is not so dark, but in neither case does pitting or corrosion take place inside of the pipes, as the scale seems to protect them from further action; this, the editorial states, is at variance with the known properties of a solution containing free chlorine.

Electrolysis of Fused Salts.—Mr. Andreoli's serial is continued in "Ind. and Iron," Jan. 12; he continues his summary of what has been accomplished in this direction.

Waves in Electrolytes.—The Lond. "Elec. Rev.," Jan. 12, contains a short abstract of the article by Mr. Yule mentioned in the Digest Dec. 30.

Accumulators in Cold Localities.—According to "La Lum. Elec.," Jan. 6, Mr. Varennes places a small incandescent lamp covered with black varnish in the liquid in each cell, in order to keep the accumulator from freezing; an automatic device, including a thermometer, connects or disconnects these lamps when the temperature falls below or rises above the freezing point.

Aluminium.—According to "La Lum. Elec.," Jan. 6, 880 pounds of aluminium are produced daily in the factory at Saint Michel by the Minet process; a water power of 1,200 h. p. is used; although a current of 6,000 amperes is used, the voltage is only 7 to 8, of which 3 are required for the decomposition.

Silver-Plating Industry.—The illustrated serial in "Ind. and Iron" is continued in the issue of Jan. 12, where scratch brushing is discussed.

MISCELLANEOUS.

Progress During 1893.—"La Lum. Elec.," Jan. 6, contains a well-written article by Mr. Ledeboer, in which he gives a general review of the progress made during the past year. For those who have read the journals it contains nothing new, as all the information has appeared in the journals; the review of the purely scientific research is interesting, but is limited chiefly to work done in France.

Institution of Electrical Engineers.—The first part of the inaugural address of the new president, Mr. Alexander Siemens, is published in the Lond. "Elec. Eng.," Jan. 12. It is chiefly of local interest, and is devoted mainly to a discussion of the retarding in the spread of the applications of electricity in that country.

Electrical Engineering and Limited Liability.—The Lond. "Elec. Eng.," Jan. 12, contains an article by Mr. Walker, in which he discusses the question whether the adoption of the limited liability principle conduces to the advancement of the best interests of those engaged; he thinks its adoption is very rarely of advantage to electrical engineers in general.

Electric Gyroscope.—The "Elek. Echo.," Jan. 6, in a well-illustrated article on gyroscopes, contains descriptions and illustrations of electrically driven gyroscopes.

Biographical.—A short biographical notice of Dr. Heinrich Hertz, by Prof. Oliver Lodge, is published in the Lond. "Elec.," Jan. 12. The "Elek. Zeit.," Jan. 11, also publishes a short biography.

Prizes.—"L'Elec.," Jan. 6, gives a list of the prizes offered by the French Academy of Sciences for the coming four years.

What Is Thought of the New Form.

I AM DELIGHTED with the new form.

Port Colborne, Ont. M. RICHARDSON.

BY FAR THE BEST ELECTRICAL PAPER PUBLISHED, and decidedly better in its new form than in its old.

Columbus, Ohio. R. J. M. DANLEY.

THE BEST ELECTRICAL PAPER IN THE WORLD. I like it better in its new dress.

Phoenix, Arizona. WM. S. PICKRELL.

I LIKE THE ELECTRICAL WORLD in its new form, in its old form, or in any form. So long as I get the paper I am satisfied.

New Durham, N. J. CHARLES BEEBEE.

I LIKE THE PAPER very much indeed and find it a great help in my work; I also like the new form, as it is much more convenient to handle and read.

Cambridge, Mass. OSCAR S. WHITNEY.

THE NEW FORM makes the paper decidedly more convenient to handle and file, and I hope your continued efforts and enterprise will meet with proper appreciation.

Vicksburg, Miss. WM. H. McCOLLOUGH.

IN MY TWENTY-SIX YEARS with the Western Union, commencing in 1855, I have seen the beginning of all electrical literature in this country, and I consider The Electrical World an honor to you and a glory to the profession.

Fabius, N. Y. W. H. JOHNSON.

A WEALTH OF INFORMATION. The Electrical World, established nineteen years ago, may fairly be considered the pioneer in electrical journalism. Published weekly, it contains a wealth of information as to all that is going on among electricians.

—Philadelphia Bulletin.

THE MODERN ELECTRIC SEARCH LIGHT. Among electrica journals The Electrical World shines out like a great electric search light. The size has been changed to a much handier one and the character of the matter, which has always been up to the standard, is now brighter than ever.

—Philadelphia Record.

FOR FIVE YEARS I have taken The Electrical World. I have always liked the matter it contained, but never the shape. In its present form, however, there is apparently nothing more to be desired, and if you continue to keep pace with the times as you have been doing you cannot fail to satisfy any reasonable subscriber.

Renfrew, Ont. A. A. WRIGHT.

FROM THE TWENTY SUBSCRIPTIONS which I send you herewith from the professors and students of the University of Minnesota, you will agree with me when I say that The Electrical World is a general favorite here at the university, both among students and professors. I am sure your friends in the Northwest are pleased with the grand, good sheet you have given them during 1893. We appreciate the Digest and the hundred and one other things that are first class in every respect.

Minneapolis, Minn. C. H. CHALMERS.

THE MOST POPULAR TECHNICAL JOURNAL. The vast importance which the electrical interests of the present day have assumed may be inferred from the fact that a recent issue of The Electrical World, the leading weekly journal devoted to electricity, contains no less than one hundred pages, and over 300 business announcements in its advertising columns, an amount of matter only exceeded by that of one other industrial or technical paper in the United States—the journal representing the iron interests. The Electrical World, which is an enterprising and handsomely illustrated weekly, is called "the most popular technical journal," and is said to have more subscribers among the general reading public than any other technical periodical.

—Albany Journal.

Windmills for Electric Lighting.

There are said to be no less than 500,000 windmills in actual daily operation in this country alone, and yet the economical value and thorough reliability of this prime mover is but little appreciated by the public at large.

The records of the Signal Service, U. S. Army, for the past fifteen years show that the wind may be relied upon to blow with sufficient velocity to drive a windmill to its average working capacity eight hours out of every twenty-four. But since there are hours of absolute calm the employment of a windmill is necessarily restricted to two classes of work. 1. To work admitting of frequent interruption. 2. To work where power can be stored for future use.

It is in work of the second class that windmills find their true field of usefulness, and they are already largely used for pumping and storing water, and for compressing air. Another use, which was first suggested by Sir William Thomson in 1881, and which has several times since then been tried with partial success, is in the production of electric light, the dynamo being driven direct from the windmill and a secondary battery being employed to store and distribute the electrical energy to the lamps.

The combination here suggested really forms an ideal method for isloated plant lighting, and it is likely to grow in favor as the advantages of the system become more generally known.

It is found by experience that it requires, on an average, a wind velocity of six miles per hour to drive a windmill, i. e., to overcome the friction of the bearings and transmitting gears, but that the mill will actually run at least eight hours per day. From this it is safe to assume that one-third the total movement of the wind is lost, so far as windmill work is concerned. The remaining two-thirds should be distributed over the eight working hours of the mill.

Mr. A. R. Wolff, M. E., in his excellent work "The Windmill as a Prime Mover," gives a table compiled from the official records of the office of the Chief Signal Officer, covering observations made at fourteen different places throughout the United States, which shows that the average monthly movement of the wind during the whole period of the observations was 5,769 miles per month. This, divided by 30, gives 192.3 as the daily movement. $192.3 \times \frac{2}{3} = 128.2$ and $\frac{128.2}{8} = 16 +$ miles = the hourly rate during the eight working hours.

Since windmills are always erected in places where the full force of the wind is felt and utilized, the above estimate of the average working velocity that can be depended upon is believed to be a conservative one.

The subjoined table shows the actual useful horse power developed by mills of different sizes manufactured by one of the leading firms in the world in this business:

Diameter of Wheel.	Weight of Mill.	Useful H. P.
14 feet.	1,600 lbs.	1
16 feet.	2,500 lbs.	1 3-5
18 feet.	2,700 lbs.	2
20 feet.	3,000 lbs.	3 1-5
25 feet.	3,600 lbs.	4½
30 feet.	4,000 lbs.	5½
36 feet.	7,000 lbs.	6¾
40 feet.	9,570 lbs.	8
50 feet.	16,000 lbs.	16
60 feet.	20,000 lbs.	26

This table is based upon the actual work done by these mills in a 16-mile per hour wind.

In the work on windmills before referred to figures are given which enable a comparison to be made between wind power, steam and gas for pumping purposes, which would equally apply to electric lighting, from which it appears, taking all the factors into consideration, that the former is more than seven times as economical as either of the latter, even when they are worked under the most favorable circumstances.

As an example of the application of the windmill to electric lighting, we illustrate a plant installed in Jersey City by the Lewis Electric Company, 120 Broadway, New York, which has been in operation for some time, and embodies several new features of great importance.

Owing to the variable speed of windmills, the few attempts heretofore made to use them for charging storage batteries

A WINDMILL LIGHTING PLANT.

for lighting have not met with much success, owing to the inapplicability of the usual form of dynamo for this purpose. The Lewis dynamo is based upon an entirely new principle, upon which letters patent have been issued to Lieut. Lewis, U. S. Army, by the employment of which the E. M. F. of the dynamo used in the plant illustrated rises only 1 1-2 volts when the speed changes from 500 to 1,600 revolutions per minute. The importance of this invention is

obvious and adds windmills to the other sources of power for electrical purposes.

The mill in question, made by A. J. Corcoran, of Jersey City, N. J., has an eighteen-foot wheel, fitted with the well-known Corcoran side-vane governor and safety lever, and has developed as much as 4 h. p. in a stiff breeze.

The dynamo is a 1-kw. slow-speed dynamo, entirely enclosed, and requiring no attention beyond oiling and occasional examination of brushes. The automatic regulation referred to, by means of which the voltage is maintained sensibly constant under great variations of speed, is attained by the method of winding the fields, the series winding being opposed to the shunt winding, as in compound motors. The machine is belted to the pulley on the mill countershaft and runs night and day, charging a storage battery of 16 cells of 150 ampere hours, which furnishes current for lamps.

The limits of speed within which the dynamo supplies current are 500 and 1,600 revolutions, the current varying between these limits from 0 to 35 amperes, and the pressure 1 1-2 volts. When the speed falls below 500 revolutions an automatic cut-out opens a switch and disconnects the battery, which is again cut in when the speed and voltage rises above an amount necessary to overcome the back E. M. F. of the cells.

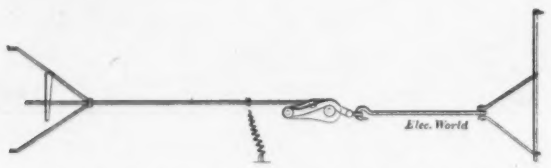
The automatic cut-out and switch, with a voltmeter and an ammeter, are enclosed in a small box attached to the wall; but as everything is automatic in operation, inspection of them is unnecessary, and the two latter may be entirely dispensed with. The writer visited the plant on a gusty day, and it was most interesting to watch the automatic action of the apparatus and the manner in which the voltage was maintained, whether the mill was turning slower than its normal rate or being furiously driven by a squall; at a critical slow speed, when the battery was being cut out and in at short intervals, there was no sparking at the cut-out switch, as at that instant there is but little current in the circuit being broken.

AUTOMATIC CUT-OUT AND SWITCH

The plant has been running night and day for more than a month, during which time it has been giving perfect satisfaction, and has demonstrated the perfect applicability of the means employed for the utilization of wind power for electric lighting.

Automatic Car Brake.

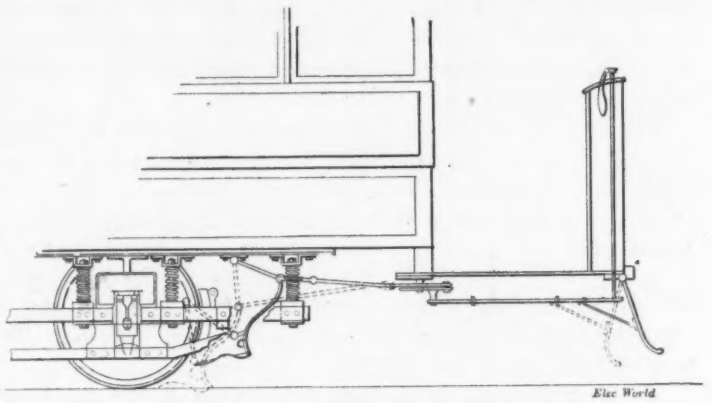
We illustrate a braking device, controlled by D. McFarlan Moore, 44 Broad street, New York, which is operated automatically by pressure upon the hinged projecting fender, or by the motorman at will. Either method moves the rod



DETAIL OF AUTOMATIC CAR BRAKE.

under the car platform, cuts off the current, or releases the cable and swings the shoes down upon the track under the wheels, which run up slightly on the shoes, blocking the car. It is evidently impossible for anything to get under the wheels, and it is equally evident that the car cannot be more effectually braked, practically, in any other manner, for the heavier the load the more effective the braking, particularly if the under surface of the shoe is slightly roughened, and for this purpose the shoe may preferably be constructed so that the roughened surface bears upon any desired part of the rail to prevent excessive wear. The shoes on either side of the car may be connected with a light wire fender to keep anything from getting under the body of the car, or if preferred the usual board fender may be fastened directly upon the shoes.

The mechanism at the point directly under the front of the body of the car, where the rod running from the hinged



AUTOMATIC CAR BRAKE.

fender connects with the rod running to the shoes—separately shown in the cut—is a simple lever, for the purpose of obtaining greater movement and of throwing the weight of the shoes upon a dead centre, it being kept there by the slight spring shown in the cut. This arrangement keeps the shoes in their proper position when raised, offers a ready means of adjustment, both as to movement of parts and delicacy of action, and prevents any operation except in the manner appointed.

The shoes may be lowered, as already stated, or raised by the motorman by means of the lever upon the platform. The handle of this lever is hinged so as to drop into a slot to prevent it being turned accidentally, and this does not interfere with the operation by the hinged fender automatically.

Storage Battery Traction.

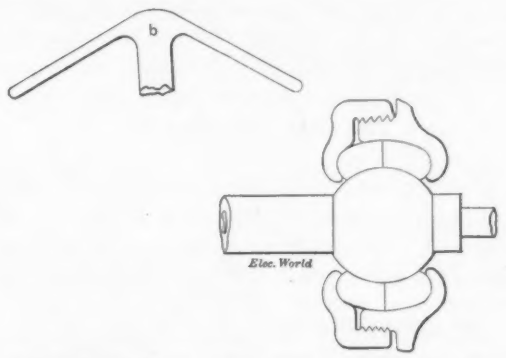
Experiments with a storage battery street railway car have been carried on over the Amsterdam avenue street railway line between 53d and 125th streets by the Astoria Electrical Manufacturing Company of New York at intervals for more than a year, and through the courtesy of Mr. W. M. McDougall, the general manager of the company, we are now enabled to publish some of the details.

The equipment consisted of an ordinary street car, fitted with a bipolar ring armature motor of high efficiency and 144 cells of the Acme storage battery, made by Kennedy & Diss, of Brooklyn. The plates of this cell consist of a central conducting plate of lead, faced on each side with rubber pierced with holes. The rubber on the two sides of the lead plate vulcanized together through interstices in the latter, which is also pierced with circular holes concentric with but smaller than those in the rubber faces. Active material is filled in the cavities thus left, the plug being held in place on account of the smaller diameter of the hole in the lead plate. Each cell has a capacity of 150 a. h., weighs 28 pounds and has an internal resistance of from .0012 to .0015 ohm.

The experimental trials were made from September, 1892, to March 1, 1893, and from May 10 to Sept. 15, 1893, the car being run daily during a good part of this time. No mishap occurred on any of the trials, and at the end the battery was apparently in excellent condition. There was a reserve of 35 cells for changes, but no cells were in a condi-

tion to be entirely discarded. The cells were connected in four sections in parallel, or two sections in series and two in parallel, or the four sections in series, corresponding to speeds of 3, 6 and 12 miles respectively. The average rate of discharge was 30 amperes, but on one section of the road, where there is a 6 per cent. grade, the discharge was 110 amperes, maintained during 3 1-2 minutes. While the battery used gave excellent satisfaction, it is proposed to employ Plante cells of an original design in the future.

From the data of these trials it was found that with 20



STUFFING BOX AND BELL CRANK LEVER.

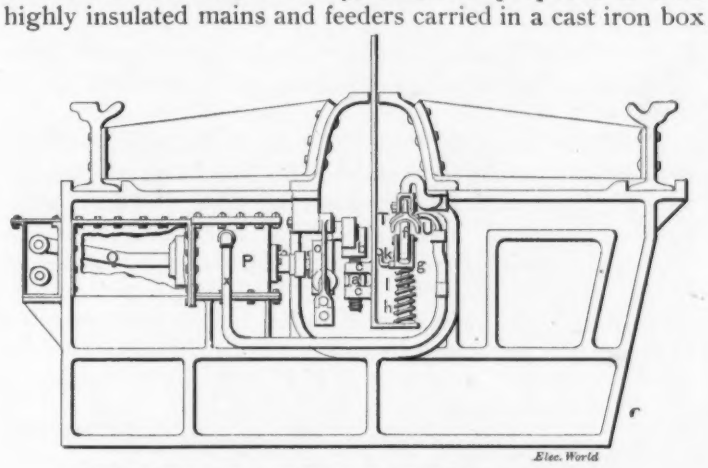
similar cars on the road the entire cost of operation, estimated on a liberal basis, and for a daily mileage of 100 for each car would be 8.03 cents per car mile, distributed as follows:

	Cents per Car Mile.
Power	2.5
Charging and labor	2.0
Repairs to motors	0.5
Oil, waste and packing	0.25
Supplies	1.00
Depreciation	1.78
Total	8.03

What data in the above were not directly determined from the trials are taken from a report of Mr. Charles Hewitt, of the General Electric Company, which was made for disinterested parties and not with a view of favoring the system. The figure for depreciation is based on an annual battery charge of 25 per cent., which is thought to be beyond what will be found necessary in any case.

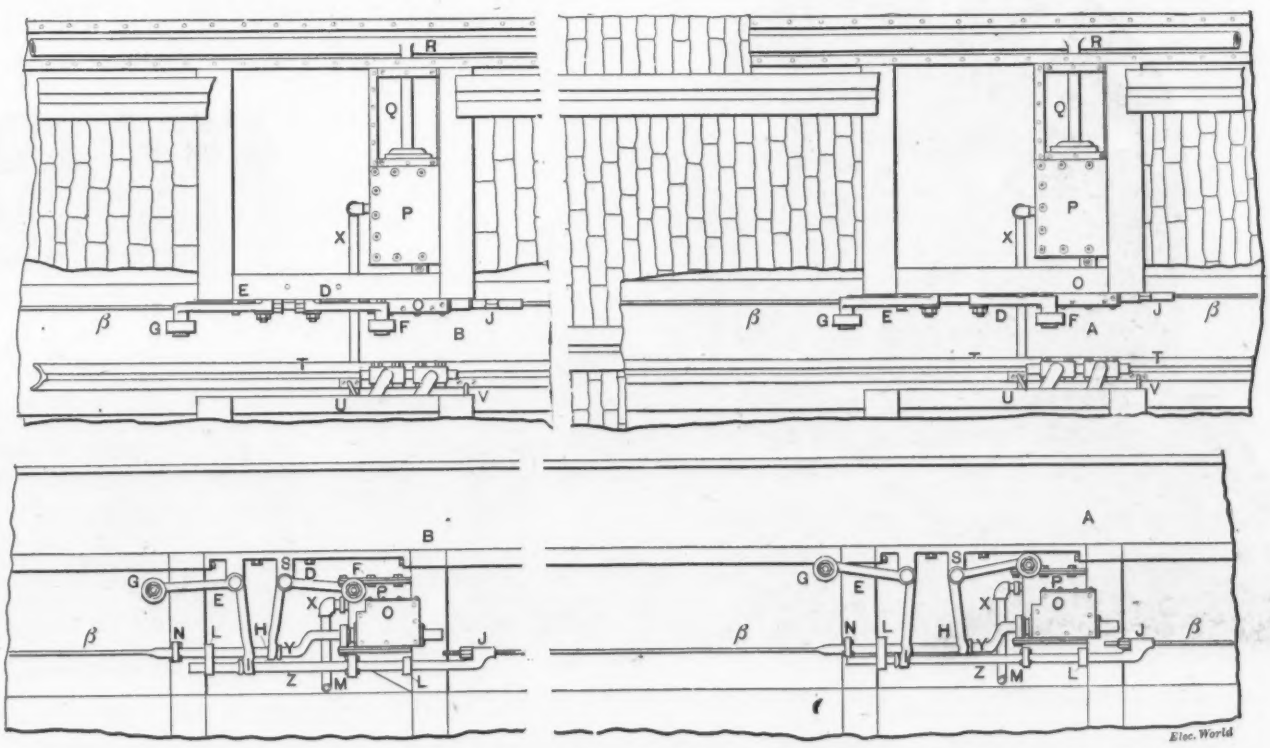
A New Conduit Street Railway System.

In the system here described and illustrated, the invention of W. Stuart-Smith, Berkeley, Cal., it is proposed to have highly insulated mains and feeders carried in a cast iron box



SECTION OF STREET RAILWAY CONDUIT.

resting on brackets on the outer end of the yoke, as shown in the cross-section. At intervals, which may be from 100 to 1,000 feet, switch boxes will be placed into which a short branch from the main leads, as shown, will pass through a stuffing box of ball and socket design. In the latest design a switch has been devised in which the wear will be so small as to insure indefinite working even if it opens and closes say 1,000 times per day. This switch is exceedingly important, and the latest one is the outcome of much thought and many designs, but as it is not yet protected, it is not here described. It is operated by suitable mechanical means,



PLAN AND ELEVATION OF STREET RAILWAY CONDUIT.

no magnetic arrangement being employed. At each switch box are placed two bell crank levers, *E*, *D*, each carrying on one arm a steel roller, *G F*, and having the other arm forked and bearing against contacts on two rods, *Y*, *Z*. As drawn the car is supposed to be running between

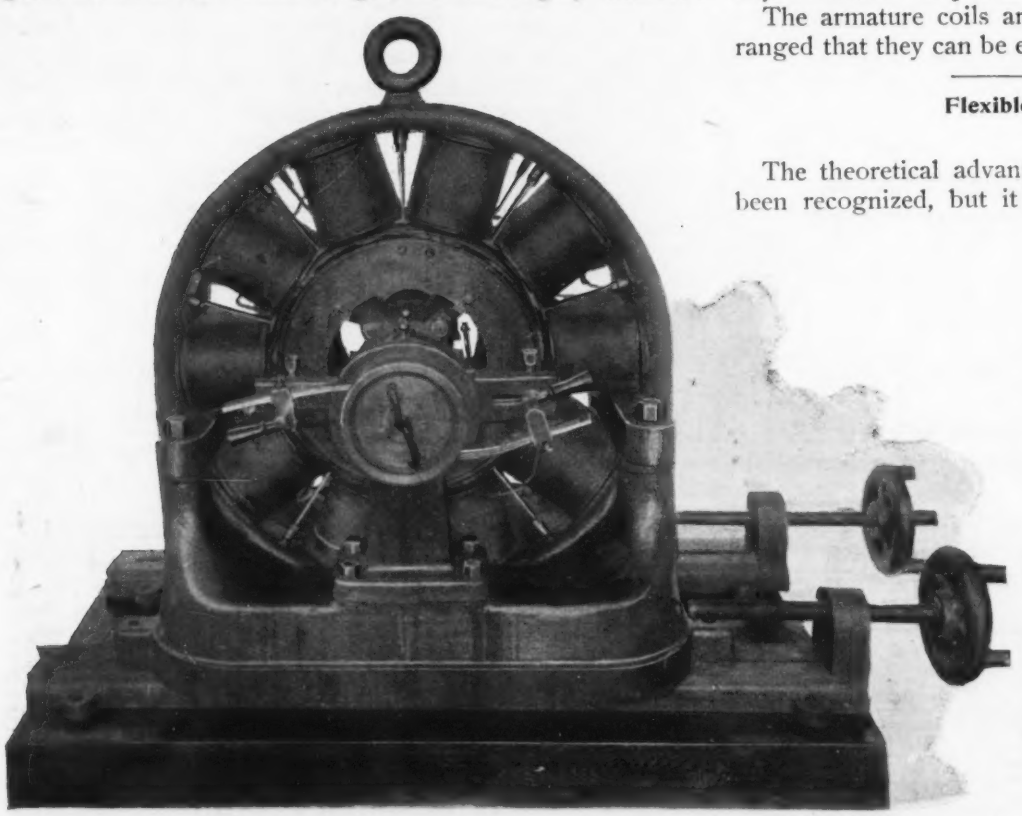
junction boxes *A* and *B*. When it reaches *B* the double angular piece *b* (shown in the section), which is carried by the car, runs under roller *F* and raises it two inches, thereby pushing the rod *Y* forward two inches and closing the switch, thus making connection between the insulated main and the previously dead section of the trolley conductor *T* beyond *B*. The car then passes on this section and a moment later the roller *G* is raised, and by means of the wire β, which runs back to box *A*, opens the switch at *A* and puts the lever *D* at *A* in position to be raised by the next car.

If the cars were kept at the proper distance apart the connections as above would be all that is necessary, but when several are bunched on section *A B* the first car to pass off would (as above shown) cut out section *A B* and leave the remaining cars stalled. This can be avoided by having a split conductor (with the two parts insulated) leading from the switch boxes to the trolley conductor and have the two parts lead to two contiguous sections of the trolley conductor, as shown at *U V*; then when the moving car lifts the roller and closes the switch at *B*, both section *AB* and the following section will be connected to the main and for a moment section *A B* of *T* will be connected to both the boxes *A* and *B*. A moment later this section is cut out at *A*, but still left connected at *B*, so that stalling of bunched cars is impossible. When the first car reaches the next following box section *A B* will be finally cut out and left dead.

The trolley conductor is to be made of iron rolled as a half cylinder, with a thin, deep rib on the back, thus giving great stiffness with small weight, and the highly insulated bare conductor will be dead even at times of heavy load.

In the section the parts lettered *a, b, c, d, f, g, h, i, k*, are carried by the car, *a* being the trolley carrier secured to the truck.

In the latest design of switch the normal movement of the rods *Y Z* and wires β is supposed to be two inches, but a variation of 25 per cent. either side of this will not affect the operation of the switch, and consequently a rough adjustment of lifting piece *b* is all that is necessary. This greatly simplifies the mechanism, as no means for taking up surplus motion, etc., are needed. The crossing of two roads is exceedingly simple and would require no attendant to be stationed there.



50 KW. ALTERNATING-CURRENT, CONSTANT-POTENTIAL DYNAMO.

The Bain Induction System.

We illustrate herewith the new Bain alternating-current dynamo manufactured by the Great Western Manufacturing Company, of Chicago, at their Duluth works. In this construction Mr. Bain has followed the general lines of alternating dynamos, paying especial attention to important details which make the apparatus highly efficient.

As will be noticed, the centre of gravity is exceedingly low, which prevents vibration and insures steadiness of running. The regulation is so adjusted that it can be over compounded to any degree in a few moments, even while the machine is at full speed. This is accomplished by an ingenious arrangement whereby the strength of the field is automatically adjusted through the exciter. This gives close regulation, and one that can be relied upon to adapt itself to any conditions of practice.

The armature coils are wound of copper ribbon, so arranged that they can be easily replaced.

Flexible Roller Bearing.

The theoretical advantages of roller bearings have long been recognized, but it is only in recent years that they have come into use for larger machinery, and as yet to only a comparatively small extent. The elastic steel roller bearing which we illustrate, made by the Hyatt Roller Bearing Company, 77 Liberty street, New York, obviates, it is claimed, the disadvantages which have restricted the use of other forms by adapting itself to every inequality of the axle or bearing, thus preventing distortion by side strains in the bearing or bending strains on the journal.

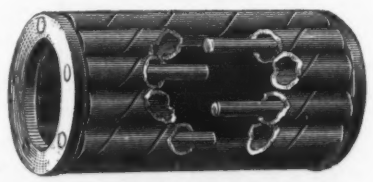


FIG. 1.—ROLLER BEARING.

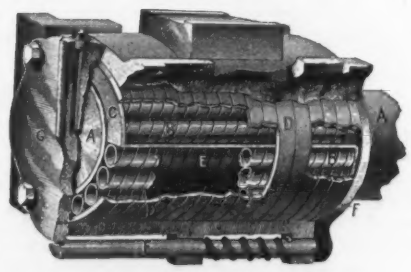


FIG. 2.—ROLLER BEARING.

The rollers are made from a single ribbon of untempered, open-hearth steel wound on a mandrel to form a close spiral. It requires no grinding or turning and rolls in a box and on a journal finished with only ordinary care. Fig. 1 shows a bearing ready for use and Fig. 2 the Hyatt bearing as applied to a motor truck, where a sleeve made of a spiral coil, in the same manner as the roller itself, is slipped over the axle and a similar but larger sleeve is slipped into the box. The rollers travel between these sleeves, which obviates the necessity for a specially finished surface on the journal or on the box, and form a wearing surface much more durable than wrought iron.

With this bearing an electrical car is started with a small fraction of the force required when it is equipped with ordinary bearings. Thus the heavy strain on the motor at the start, which is such a prolific cause of burned out armatures, is relieved, less power is wasted in the rheostat, and the car starts with less shock and jerk to the passengers. The saving in power due to the use of such bearings may save overloading a central station or a line wire, and may thus avoid expensive burn-outs or the replacing of the line wire by a larger size, which has been found necessary on many roads. For trolley wheels the Hyatt roller bearing is particularly applicable, as it is more durable than the bushings ordinarily used and will save the trouble and annoyance caused by ordinary trolleys. The wear on the line wire is also reduced owing to the easy running of the trolley.

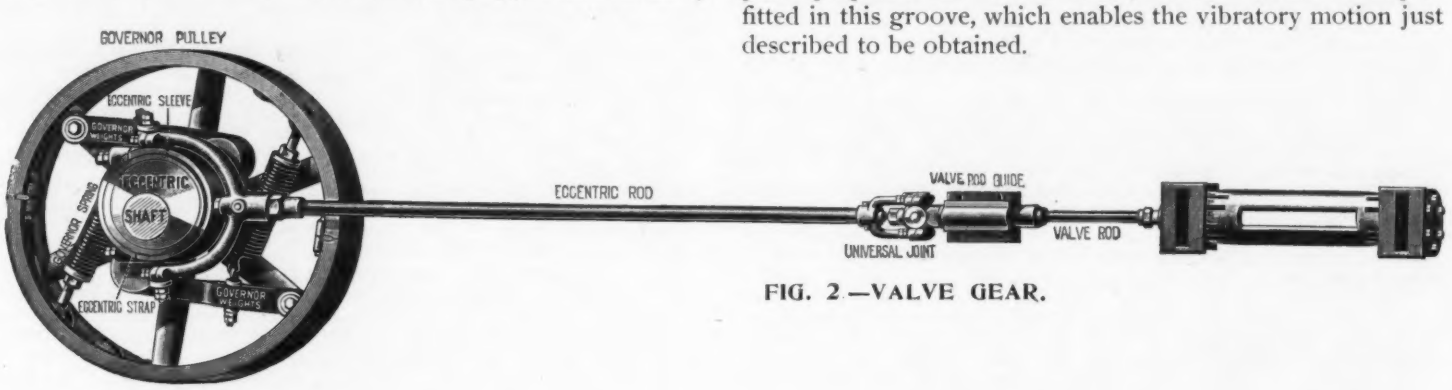


FIG. 2.—VALVE GEAR.

An Improved Automatic Engine.

An automatic engine with an unusually interesting valve gear has recently been placed upon the market by the American Engine Company, Bound Brook, N. J. Both main and cut-off valves are worked by one and the same eccentric and valve rod, the former by the motion of translation, and the latter by a vibratory motion of the rod.

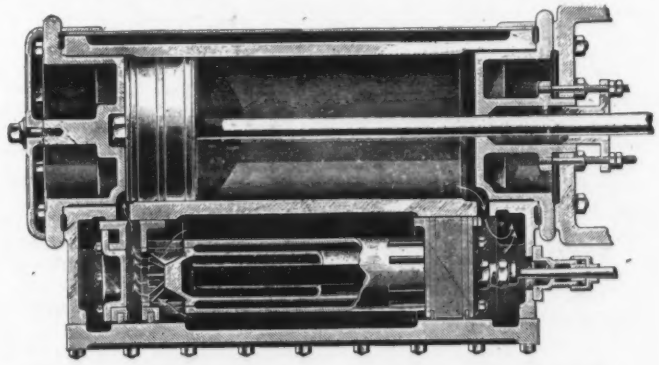


FIG. 1.—CYLINDER, VALVE AND VALVE CHEST.

Figs. 1 and 2 show the two valves, the cut-out being within the main valve. Steam is admitted into the middle of the valve chest and is allowed to pass into one or the other end of the main valve by the cylindrical interior cut-off valve through the openings shown, and thence passes into the cylinder. The exhaust passes directly into an exhaust opening at either end of the cylinder.

Figs. 2 and 3 show the eccentric and method of obtaining the vibratory motion of the valve rod. On the eccentric is a sleeve controlled by a usual form of flywheel governor, but instead of the eccentric strap being at right angles on this sleeve, as usual, it is fitted at an angle, so that with the revolution of the sleeve it passes from the extreme angle shown in Fig. 3 to a corresponding angle on the other side of the vertical position. A V-shaped groove is turned in the sleeve, so that a plane passing through it is at an angle to a plane perpendicular to the sleeve, and the eccentric strap is fitted in this groove, which enables the vibratory motion just described to be obtained.

The main and cut-off valves have the same motion of translation, and at the proper moment, which is determined by the governor, the longitudinal ports in the main valve are opened by the cut-off valve turning, thus admitting steam to the cylinder through the main ports.

By the means here employed the compression and release are maintained constant at all loads and all of the advantages of a separate cut-off obtained with the use of only a single eccentric and valve rod; other features are the small clearance space and the exit of the exhaust steam without passing over surfaces outside of the ports, which are afterward in contact with live steam.

Mechanically, the engine is well designed and well made, and promises to take a leading place among high-speed engines.

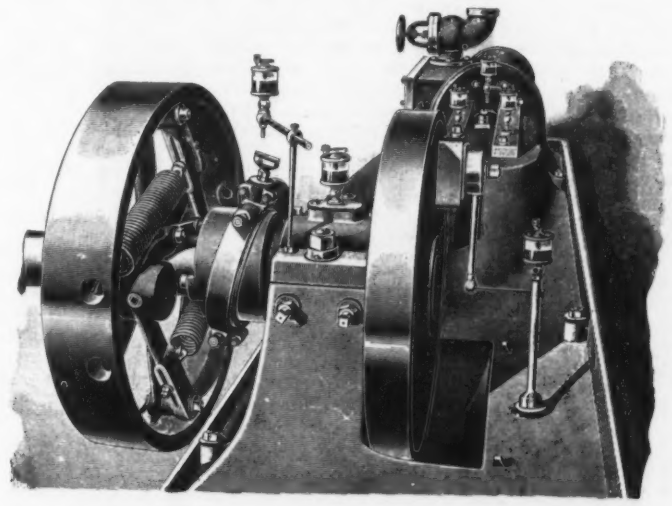


FIG. 3.—GOVERNOR AND ECCENTRIC.

Rather Peculiar.

It is perhaps curious that though many newspapers give prices current, they do not include prices for current.—London "Electricity."

Financial Intelligence.

The Electrical Stock Market.

New York, Jan. 29, 1894.

THE ELECTRICAL STOCK MARKET has presented a dull and uneventful week. There have been no transactions of any note and the market has seemed to be devoid of any life or interest. Now that the silver and bond questions are settled, Wall Street has another subject for the cause of hard times in the tariff issue. It is now said that until the revenue policy of the government is established, financial depression will prevail. Whether it is legislation or an over production and greedy speculation amongst the business community is a question with financiers.

ONE OF THE OLD TIME BROKERS in electrical stocks said the other day that low as electric securities now are and with every reason for their appreciation in the future, it was almost impossible to make any sales. When there are unquestionable securities, as government bonds, offered for sale, the public grabs at the opportunity, but is still very loath to invest funds in any industrial securities, good as the intrinsic values of some electric stocks are.

GENERAL ELECTRIC.—This week's transactions in General Electric are in marked contrast with those of last. While in the preceding week it was foremost in the list of active industrials, this week it has hardly been mentioned in any of the great sales, and closes 1¼ points lower than the closing quotation of a week ago. The chief cause affecting the quotation was the general stagnation and lagging of all industrials. There were no outside rumors of financial troubles of the company which might cause a decline.

THE DECISION OF JUDGE RICKS, of the United States Circuit Court of Ohio, declaring the Edison incandescent lamp patent expired on Nov. 10, is rather an offset to the recent favorable decisions the General Electric people have received. The Ohio suit was one of the Edison Electric Light Company against the Buckeye Electric Company. Judge Ricks holds that the correction of the patent made by the Patent Office at the request of the Edison company limiting the American patent to the term of the English patent constituted a dedication to the public of the remainder of the term of the American patent after the English patent expired. He further holds that the Edison company is estopped by procuring this correction from claiming that the American patent runs longer than the English patent. It seems as if the General Electric people were under the utmost difficulties to hold on to their incandescent lamp monopoly.

THE WESTINGHOUSE ELECTRIC COMPANY is now making great strides in the business world. Despite the hard times the company is reported as doing a business of $6,000,000 per annum, and has now 2,000 hands employed at its Pittsburg works. From the great competition and keen rivalry among the big electric companies, the Westinghouse gains have not been large, yet it is making a fair manufacturing profit, and the company's future is as bright, if not brighter, than any other electric concern. The new plant which the Westinghouse company has already contracted for will enlarge the company's facilities enormously, as besides having all modern improvements the location permits the establishment of all departments under one roof, thus reducing running expenses. The big electric plant which the company built for the Niagara Cataract Construction Company was tested during the week with satisfactory results. This and other triumphs which the Westinghouse people have attained in the electrical engineering field must ultimately make the stock one of the most valuable of electrical securities. The present quotations, 24½ for the preferred and 43 for the common, have been the ranging prices of the stock for the last three months. As the par value of the stock is 50, these figures, low as they are, compare favorably with other electrical stocks.

THE NEW YORK AND NEW JERSEY TELEPHONE COMPANY has increased its capital stock from $2,535,000 to $3,500,000. The amount of capital of the company actually paid in is $2,535,000, and the whole amount of the debts and liabilities is $1,735,000. The increase of $965,000 in its capital is made to meet business extensions in the ever-growing telephone field.

THE NEW ENGLAND TELEPHONE COMPANY has declared a quarterly dividend of $1.25 per share.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	96	99
" " " 1sts	—	104¾	105
Edison Electric Ill., Brooklyn	100	99	101
" " " Boston	100	112	117
" " " Chicago	100	145	150
" " " Philadelphia	100	120	130
Edison Electric Light of Europe	—	—	5
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	4	8
General Electric Company	100	34¾	35⅛
" " " deb. 5's	—	72	74
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	41	43
" " " pref.	50	23½	24½
Western Union Telegraph	—	84⅛	84¼

New Incorporations.

SALT LAKE CITY, UTAH.—The Jordan River Generating Company, with $50,000 capital, has been incorporated. Charles S. Walker, Frank Harris and Frank Knox are interested.

THE HUBLEY MANUFACTURING COMPANY, of Lancaster, capital stock $200,000, has been formed to manufacture, electric, steam and mechanical toys, etc. J. E. Hubley, F. H. Steacy and D. B. Shenk are interested.

C. AND P. MANUFACTURING COMPANY, Brooklyn, N. Y., capital stock $20,000, has been formed to manufacture electrical, steam and other machinery and appliances. M. T. Davidson, William D. Parry, William A. Drewett, all of Brooklyn, are the interested parties.

CENTRAL ELECTRIC SERVICE COMPANY, Milwaukee, Wis., capital stock $100,000, has been formed to manufacture and deal in heat-regulating apparatus, electrical and pneumatic specialties, etc. The promoters are Francis Hinton, William F. Powell and William D. Van Dyke.

CENTRAL MASSACHUSETTS ELECTRIC COMPANY, Palmer, Mass., capital stock $150,000, has been formed to manufacture, buy, sell, use and transmit electricity for the purpose of furnishing light, heat and power. The promoters are A. M. Young, Chas. B. Fiske and Rufus Flynt.

THE NEW SHARON ELECTRIC LIGHT AND POWER COMPANY, New Sharon, Iowa, capital stock $12,000, has been formed to construct and maintain an electric light and power plant at New Sharon, Iowa. The promoters are L. H. Ong, J. Watland and P. Batliff, all of New Sharon.

THE ELECTRICAL ANNUNCIATOR COMPANY, Portland, Me., capital stock $500,000, has been formed to manufacture, deal in and use all kinds of electrical and mechanical apparatus. The organizers are E. W. Mann, Norfolk; E. S. Taylor, Quincy, Mass.; and A. C. Allyn, Rochester, N. Y.

THE CARD ELECTRIC COMPANY, Mansfield, Ohio, capital stock $100,000, has been formed to manufacture and sell electric street railway equipments, stationary electric motors and dynamos, street car heaters, etc. Reid Carpenter, H. M. Weaver, B. F. Crawford and S. A. Jennings are interested.

THE SLATINGTON STREET RAILWAY COMPANY, Allentown, Pa., capital stock $30,000, has been formed to construct and operate an electric railway in Lehigh county. The promoters are R. W. Mosteller, Henry Bittner, John W. Ballitt, Slatington, Pa., and Morris Hoats, 618 Hamilton street, Allentown, Pa.

THE CHICAGO ACCUMULATOR COMPANY, Chicago, Ill., capital stock $300,000, has been formed to acquire patents concerning inventions for the improvement of electrical storage batteries, appliances for furnishing electrical motive power, etc. G. E. Plumb, F. W. Moore and C. E. Ridpath are the promoters.

THE GENERAL ELECTRICAL CONSTRUCTION AND SUPPLY COMPANY, Dayton, Ohio, capital stock $10,000, has been formed to manufacture, purchase and deal in electrical appliances and supplies. G. B. Butterworth, H. H. Heathman, W. F. Breidenbach and H. W. Pleasant are the interested parties.

THE WOLF ELECTRICAL PROMOTING COMPANY, Cincinnati, Ohio, capital stock $15,000, has been formed to purchase letters patent and manufacturing and selling improvements in electrical fabric cutting machinery, etc. Jacob Block, J. Wolf, Jr., F. Elsbach, A. Bloch and J. B. Frenkel are the incorporators.

WEST WATER POWER AND LIGHT COMPANY, West, Tex., capital stock $25,000, has been formed to supply the public with water for all purposes, and also to supply heat, light and electric motor power to the public. John Brazelton, J. J. Holt, T. M. West, J. B. Cook and W. W. Glasgow are the organizers.

THE METROPOLITAN ELECTRIC EQUIPMENT COMPANY, New York, N. Y., capital stock $20,000, has been formed to equip and install electric plants. M. T. Ward, 515 E. 161st street; St. Darius Columbani, 78 W. 48th street, New York, and J. F. Hughes, 67 Patchen avenue, Brooklyn, N. Y., are the promoters.

MADERA ELECTRIC COMPANY, San Francisco, Cal., capital stock $100,000, has been formed to construct, operate and deal in electric works, waterworks, gas works and in the producing thereof. The promoters are F. W. Krogh, Charles A. Krogh, George G. Buckland, San Francisco, Cal., and Sol. Lazar, H. K. Olsen, Madera, Cal.

RAILROAD ELECTRIC SAFETY APPLIANCE COMPANY, Kittery, Me., capital stock $1,000,000, has been formed to do a general business in appliances for the protection of life and property on railroads. Edward L. Orcutt, Somerville, Mass.; John R. Green, Everett, Mass., and Elmer N. Hutchins, Somerville, Mass., are interested.

KEYSTONE ELECTRIC CONSTRUCTION COMPANY, LTD., New Orleans, La., capital stock $25,000, has been formed to buy, sell, or erect machinery of every kind, and to make contracts for doing everything connected with the erection of steam and electric plants. William I. Mathews, Alcie Bouchereau and Emile Jordy are the interested parties.

BRADDOCK AND HOMESTEAD STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock $7,500, has been formed for constructing and operating an electric railway from Rankin

Borough across the Monongahela River to Munhall Station, Allegheny county, Pa. W. C. Jutte, E. K. Morse and Geo. W. Theis are the interested parties.

THE METROPOLITAN CONSOLIDATED ELECTRICAL COMPANY, New York, minimum capital stock $500, has been formed to manufacture, use and sell all kinds of mechanism and manufactured products, including various kinds of electrical goods, machines, etc. H. C. Andrews, W. J. Meagher and J. H. Bartlett, all of New York, are the incorporators.

BROOKLYN, N. Y.—The C. &. P. Manufacturing Company, of Brooklyn, $20,000, has been incorporated to manufacture certain electrical, mechanical and other appliances owned and controlled by A. Churchward and William D. Perry. The directors are Marshall T. Davidson, Joseph F. Scholes, Harry H. Starkey, William D. Perry and William A. Brewett, of Brooklyn.

THE FOGERTY GAS AND CHEMICAL COMPANY, Chicago, Ill., capital stock $10,000,000, has been formed for operating works for manufacturing and distributing gas and electricity; operating plants for manufacturing such chemical salts, elements, etc., for making coal gas; dealing in patents and patent rights, etc. The promoters are Ambrose A. Worley, John C. Satterlee and N. H. Hanchette.

THE PEOPLE'S LIGHT AND POWER COMPANY, Newark, N. J., capital stock $2,000,000, has been formed to construct, purchase, lease, sell and operate works and plants for the manufacture and distribution of electricity, steam and gas for light, heat and power. The promoters are James K. Corbiere, Caldwell, N. J.; Joseph L. Munn, James E. Reynolds, East Orange, N. J.; Thos. A. Nevins, Orange, N. J., and Elisha B. Gaddis, Newark, N. J.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Jan. 29, 1894.

PROF. F. B. CROCKER lectured before the Franklin Institute, Philadelphia, on Jan. 20, on "The Electric Motor."

BROOKLYN ELECTRICAL LABOR UNIONS are at war and their contentions threaten to embroil 60,000 wage-earners, including other trades.

DR. S. S. WHEELER delivered the second lecture of the University extension course at Cooper Union on Jan. 22, the subject being "Dynamos and Motors."

THE WILSON PLAN of rapid transit by underground trains continues to gain in favor, but it is hinted it will be eventually killed by Manhattan elevated influence.

THE PHILADELPHIA EDISON COMPANY has sent a bill to the General Electric Company for $61,000, the amount it claims to have lost through not being protected against infringers selling lamps in its territory.

MAYOR SCHIEREN, of Brooklyn, proposes to take vigorous action in order to prevent trolley cars running faster than the speed permitted by law. Recently Prof. Plympton reported that he found from actually timing cars that many were running at rates from 12 to 19 miles per hour.

MR. THOMAS C. PERKINS, vice-president and general manager of the Mather Electric Company, of Hartford, Conn., was in New York on Saturday on business. The reorganized Mather Company includes among its officers and stockholders some of the best known and most succssful business men of Connecticut. The company will soon be ready to place upon the market some of its latest design machines, which it is thought cannot fail to attract considerable attention among the electrical fraternity.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 27 1894.

THE WASHBURN & MOEN WIRE WORKS, of Worcester, Mass., have largely added to their working force this week.

THE UNDERGROUND WIRES question and municipal lighting are still in active agitation by the Massachusetts legislative committees.

THE GAMEWELL FIRE ALARM COMPANY'S offices on Pearl street, Boston, were slightly damaged by smoke at the recent fire in their building.

KEENE, N. H., has about made up its mind that it ought to have a street railway, and that, if it has one, it must be one run by electricity.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, recently declared a dividend of 1½ per cent., which is a reduction from 8 to 6 per cent.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY has expended more than a million of dollars on its underground cable conduits.

THE SUBWAY COMMISSIONERS of Boston report that they will soon be ready to present a bill before the Legislature, and estimate that the total cost of the subway will not exceed $5,000,000.

MR. F. C. BREWSTER, of the Elson & Brewster Engineering Co., 141 Liberty street, New York City, and Mr. P. C. Burns, of the Laclede Carbon and Electric Company, of Kokomo, Ind., were recent Boston visitors.

GARDNER, ME.—An electric railway is now practically a certainty. The necessary 500 shares of stock have been subscribed for, and directors will be elected as soon as the requirements of the law have been fulfilled.

A NEW ELECTRIC RAILWAY SYSTEM.—The legislative committee on street railways visited Salem on Jan. 22 and inspected E. H. Brown's magnetic electric railway. This is a recent invention, and many remarkable features are claimed for it.

H. C. DEANE, machinist and manufacturer of special machinery, No. 1 Main street, Fitchburg, reports business as improving and that there is an excellent demand for the Deane improved reducing wheels for slow or high speed upright or horizontal engines.

MR. HERBERT P. BROWN, brother of Mr. Maybin W. Brown, succeeds Mr. E. O. Johnson as travelling representative of the Brown Electric Company. He is well and favorably known to the electrical trade, understands thoroughly its wants and will undoubtedly prove a successful outside representative.

THE BRADBURY-STONE ELECTRIC STORAGE COMPANY, of Lowell, manufacturers of the "Ideal" storage battery, has just issued a new illustrated catalogue, No. 4, with price list. The catalogue is replete with valuable information as to the merits of its manufactures, which is abundantly substantiated by testimonials.

ON PETITION of the General Electric Company, because of a claim of $60,000, Judge Edgar Aldrich, of the United States Court for the District of New Hampshire, has appointed William F. Brewster receiver for the Consolidated Light and Power Company, of Dover, N. H. Mr. Brewster, who is a Boston electrician, filed a $10,000 bond.

MR. MAYBIN W. BROWN, of the Brown Electric Company, leaves Boston next Tuesday for Florida, from which point he will make an extended Southern trip in the interest of his company, presenting particularly its well known street railway supplies and specialties. He will be absent about six weeks, returning by way of Washington to be present at the meeting in that city of the National Electric Light Association.

THE W. S. HILL ELECTRIC COMPANY, 133 Oliver street, Boston, has just received another large order for switches from the Philadelphia Traction Company, the third one it has received in quick succession from this company. The Hill company is as busy as it very well can be with general electric work, to keep up with which it has been compelled to add to its facilities, and it looks now as if it might very soon outgrow its present location. Messrs. Hill, Poor and Everett, the management of the company, are to be congratulated over the success which is attending their efforts.

THE ELECTRIC HEAT ALARM COMPANY, of Boston, has recently contracted for the installation of its automatic fire alarm system in the building housing the live stock of Hon. Levi P. Morton at his summer residence at Rhinecliff, N. Y. The contract was effected through Architect Charles C. Haight, representing Mr. Morton, who spent a great deal of time examining the various fire alarm systems and finally selected that of the Electric Heat Alarm Company because of its superior thermostat and system of wiring.

THE COLUMBIA ELECTRIC COMPANY, of Worcester, Mass., has purchased the business of the Worcester Electric Engineering and Construction Company, of that city. Its business office will hereafter be in the Burnside Building, 339 Main street, continuing the manufacture of dynamos and motors, for the present at least, at 180 Union street. It would seem that this company is on the eve of a successful business. It is just about completing a very important installation in connection with the Chemical Precipitation Plant of Worcester. The Columbia company has also recently installed a 600-light plant for Isaac Prouty & Co., of Spencer, Mass., and other smaller installations. Messrs. John P. Coghlin and Frank E. Gilbert are the managers of this company.

ON SATURDAY EVENING, Jan. 20, at Young's Hotel, a very happy little dinner party was given by Mr. W. R. Watters, who severed his connection with The Electrical World as its New England representative on this date, to the representatives in Boston of the electrical journals. There were present H. G. Tuckerman, of "The Electrical Review"; A. C. Shaw, of "The Electrical Engineer"; W. S. Key, of "Electricity"; R. F. Ross, of "The Electrical World," and G. M. Angier, of the Mather Electric Company, a personal friend, not only of Mr. Watters, but of all present. A very pleasant evening was enjoyed, the interchange of kindly sentiments as brother journalists and congratulations to Mr. Watters rendered the occasion a particularly enjoyable one. Mr. Watters will hereafter represent "The Street Railway Journal" in New England.

Western Notes.

Branch Office of The Electrical World
936 Monadnock Building, Chicago, Jan. 27, 1894.

THE COLUMBIA LAMP COMPANY, of St. Louis, is enjoying a season of unparalleled business. The factory facilities of this company, which from time to time have been increased, are today taxed to their utmost capacity. This popular company continues to furnish the well-known Columbia lamp in large quantities to purchasers on shortest notice.

THE CENTRAL ELECTRIC COMPANY sells one of the oldest and probably best known commutator conserver on the market—that known to the trade as "Gales." The Central people state that this conserver has been largely used by central station men for the last five years, and that they know of nothing that has replaced it, and that the demands upon them for this article is steadily increasing.

THE STAR ELECTRIC LAMP COMPANY, Chicago, manufacturers of the "Sunbeam" lamp, has changed its name to The Sunbeam Lamp Manufacturing Company. The policy of this company is to furnish lamps superior in quality. Recently some discoveries have been made, as the result of the extensive experiments they have carried on, which they claim will greatly improve the quality and add to the value of their lamp.

MESSRS. P. THOMAS & SONS' COMPANY, manufacturers of porcelain standard goods, East Liverpool, Ohio, has opened an office at 115 Dearborn street, Chicago, under the management of Mr. J. E. Way, who is very popular and well known to the trade. Mr. Way will carry a complete stock of all kinds of standard cleats and insulators. This company has a warehouse at 142 Lake street, Chicago, where a full line of porcelain standard goods is constantly on hand.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY is introducing a new lamp which it calls the "Republic." This lamp is a high grade lamp equal to many so called lamps on the market. The guaranteed life of this lamp is 600 hours. Certain materials entering into the construction of this lamp not so expensive as those in the widely known "American" lamp, allow them to make it at a competitive price. The "American" will still be furnished to all desiring it with the usual guarantee of 1,000 hours.

THE HULINGS ELECTRIC COMPANY, of East Liverpool, Ohio, incorporated under the laws of the State of Ohio, for the purpose of manufacturing electrical supplies, is fast acquiring an envious reputation in its section of the country though having commenced business only last July. This company makes a specialty of tablet boards, rosette cut-outs and switchboards, more especially the former. Notwithstanding the existing financial depression, this company has had all it could attend to since its advent. In addition to the specialties above mentioned, this company will, in a few weeks, also manufacture sockets and other electrical specialties.

News of the Week.

Electric Light and Power.

SUN PRAIRIE, WIS.—An electric lighting plant will be put in before spring.

CINCINNATI, OHIO.—The city hospital is to be ventilated throughout by electric fans.

BALDWIN, MICH.—F. L. Prindle and J. Schultz are projectors of the proposed electric lighting plant.

KALAMAZOO, MICH.—An ordinance has been adopted looking to the establishment of a city plant to cost $15,000.

SAUGATUCK, MICH.—The business men are talking of putting in a small electric plant to light the business places.

ST. BERNARD, OHIO.—An election will be held Feb. 24 to vote on the issue of $85,000 waterworks and electric light bonds.

YORKVILLE, PA.—Residents of Yorkville have asked the borough council to take action in the matter of an electric light plant.

ST. CHARLES, MO.—An ordinance is before the Council providing for the establishment of an electric lighting plant by A. Speirs.

CHARLESTON, S. C.—The Charleston Electric Light Company has been authorized to increase its capital to $175,000 for improvements.

ADA, OHIO.—Owing to a misunderstanding between the Ada Electric Light Company and the Council of Ada the city is in darkness.

WHITEHALL, N. Y.—The plant of the Whitehall Electric Light and Power Company has been burned; loss, $8,000, with no insurance.

DAWSON, GA.—Citizens are subscribing liberally to the proposed $10,000 electric lighting plant which it is proposed to build and operate in Dawson.

POWELTON, PA.—The office of the Powelton Electric Company is at 108 South 40th street, Philadelphia, Pa., and J. B. Stauffer is secretary-treasurer.

MANCHESTER, MASS.—There is grave complaint of the lighting of the Town Hall, and residents are urging that an electric lighting plant be established.

MOUNT MORRIS, N. Y.—There is talk of organizing a stock company for the construction of an electric lighting plant, but nothing definite has been done.

CAMBRIDGE, MASS.—J. H. McNamee, of 418 Harvard street, Cambridge, Mass., will put into his new building a dynamo for power, light and elevator service.

NAPOLEON, OHIO.—Edward Sykes, of Minneapolis, Minn., has the contract to put in the electric lighting and waterworks plant, and work will at once be begun.

GLASSBORO, N. J.—The movement to supply Pitman Grove, Glassboro and Clayton with water and electric lights has been abandoned owing to the lack of water power.

CINCINNATI, OHIO.—The city authorities have ordered the local Edison company to carry out the terms of its contract with the city, which, it is asserted, have been violated.

EAST ORANGE, N. J.—Residents of East Orange have decided in favor of incorporation, which means that they will soon contract for an electric lighting and waterworks plant.

KALAMAZOO, MICH.—The City Council has adopted a resolution that a city lighting plant be built at a cost of $145,000. The city now pays $15,000 per annum for street lighting.

PORT RICHMOND, S. I., N. Y.—At a meeting of the Board of village Trustees, the question of purchasing the electric lighting plant was brought up again, but no definite action was taken.

WHEELING, W. VA.—The business men of Market street, from 12th to Alley 9, have made arrangements to put in an electric lighting plant for the purpose of supplying stores and offices in that vicinity.

MANKATO, MINN.—The City Recorder has been instructed to call for bids for lighting the city for ten years. If no satisfactory bids are received the Council will take steps to establish an electric lighting plant.

YORKVILLE, PA.—The Council of Yorkville is discussing the proposition of the Edison Electric Light Company, of Pottsville, to furnish electric lighting to Yorkville. Superintendent Halderman, of the Pottsville company, is interested.

WEST NEW BRIGHTON, S. I., N. Y.—Ordinance Officer Eichenberger has reported to the Board of Trustees that the present electric lighting service is most unsatisfactory, but no action has yet been taken officially towards improvements.

HAMPTON, IOWA.—J. M. Hemingway has presented the proposition of the Hampton Electric Light Company to sell their plant to the city for $13,000, or to light the streets with 15 arc lights for $75 each per annum. Both proposals were rejected.

CHATHAM, N. Y.—It is rumored that the Chatham electric light plant has not proven a profitable investment for the General Electric Company and that they propose to remove it. In that case, Thomas E. Syernes contemplates putting in a light and power machine at his mill.

THE LITTLE ROCK (ARK.) ELECTRIC LIGHT COMPANY at its recent annual meeting elected the following directors: James A. Fours, R. A. Edgerton and John G. Fletcher. James A. Fours was elected president, Philip Pfeifer treasurer and James T. Pullen secretary and superintendent.

BALTIMORE, MD.—It is now stated that the Baltimore and Ohio Railroad is back of the scheme to operate the Chesapeake and Ohio Canal by electricity. Charles K. Lord, third vice president of the B. & O., is one of the incorporators. It is proposed to haul heavy freight on the canal by trolley.

REEDSBURG, WIS.—At a special meeting of the City Council it was decided to push forward the project of establishing waterworks and the proposed electric light plant. Twenty-five thousand dollars in bonds have been issued. Plans and specifications have been prepared and bids will soon be called for.

NEW YORK, N. Y.—A delegation of New York members at Washington will ask for an appropriation of $58,000 for improvements in the New York City Postoffice. At present the annual expenditure for gas and electricity is $42,000, but with a smaller sum it is figured that the government could put in its own plant.

NEWARK, N. J.—The People's Light and Power Company, $2,000,000 capital stock, has been incorporated to furnish electricity, steam and gas to Newark, Orange, East Orange, Bloomfield, Montclair, Harrison, Kearny and Jersey City. The incorporators are James K. Corbiere, Joseph L. Munn, James E. Reynolds, Elisha B. Gaddis and Thomas A. Nevins.

BRIDGEWATER, MASS.—Howard T. Marshall, of Brockton, Mass., a wealthy retired shoe manufacturer, proposes to supply East Bridgewater with electric lights, the power house to be located in the old Sheldon Mill, where he will locate an engine and a 150-h. p. boiler. The franchise for setting poles and running wires has been promised Mr. Marshall by Robert O. Harris, the present holder of the franchise.

The Electric Railway.

BRADDOCK, PA.—A charter has been granted to the Braddock and Homestead Street Railway Company.

CHICAGO, ILL.—Prof. J. P. Barret, of Chicago, is in favor of the perfected Love conduit system for use in Chicago.

BORDENTOWN, N. J.—Surveys are being made with a view to locating an electric line between Bordentown and Trenton.

WAVERLY, N. Y.—The Electric Street Railway Company has bought land for the erection of a power house on Cayuta avenue.

SAVANNAH, GA.—The reserve power house and car sheds of the Savannah, Ga., electric railway have been burned; loss, $50,000.

HAVERSTRAW, N. Y.—There is talk of a trolley line between Haverstraw and West Haverstraw, but nothing definite has been done.

RACINE, WIS.—The street railway company has increased its capital by $50,000 to defray the cost of an extension to Mount Pleasant and Caledonia.

LIBERTY, MD.—The Liberty "Banner" calls upon residents to take immediate action towards building an electric road from Union Bridge to Liberty.

CHICAGO, ILL.—The Lake Street Elevated Railroad Company, of 1,103 Security Building, will build an electric light plant at 1,331 West Lake street, to cost $7,000.

BALTIMORE, MD.—Warrants have been isued for the presidents of five street railway systems for violation of a city ordinance requiring the use of car fenders.

HUNTINGTON, L. I., N. Y.—The Oyster Bay "Pilot" has again taken up the agitation for an electric trolley line to connect Oyster Bay, Huntington and Cold Harbor.

CENTRALIA, N. Y.—D. Putnam, of Centralia, is moving in the matter of an electric road from Jamestown to Brocton, but nothing definite has yet been done.

BRIDGETON, N. J.—The Council of Bridgeton has passed on first reading the ordinance granting a franchise to the Bridgeton, Cedarville and Port Norris Electric Railroad.

ALBANY, N. Y.—Assemblyman Gardiner has introduced a bill authorizing the Amsterdam Street Railway Company, of Amsterdam, N. Y., to supply light, heat and power.

YOUNGSTOWN, OHIO.—Some of the contracts for the plant of the Ohio Street Railway Company have been let. Fifteen electric motors will be required. Henry Wick is general manager.

BRISTOL, PA.—After a fight of over a year, the Council has granted a franchise permitting the Bristol, Trenton and Newtown Trolley Railway to lay tracks on many of the streets here.

BUFFALO, N. Y.—W. B. Cutter, of Buffalo, N. Y., has stated to the Buffalo "Express" that the proposed electric line to Depew will likely be built this summer. It could be built for $75,000.

NEW BRITAIN, CONN.—The Street Committee has reported favorably on the petition of the Central Railway and Electric Company to extend their lines to Berlin, and the report was adopted.

McKEESPORT, PA.—The officials of the Versailles Traction Company are being urged to begin work at once on the proposed extension of their lines to Elrod, in order to give work to the unemployed.

NORWALK, OHIO.—Work on the West Main street extension of the Sandusky, Milan and Norwalk Railway will commence as soon as the weather will permit. S. E. Crawford and W. H. Price, of Norwalk, Ohio, are directors.

SPRING CITY, PA.—The Town Council of Spring City has granted a franchise to the Phoenixville Electric Street Railway Company to run cars through this borough. The road will connect Phoenixville, Valley Forge and Spring City.

MYERSVILLE, MD.—The company recently organized to build an electric road from Myersville to Middletown now contemplate making Brunswick the terminus, and they will soon complete the sale of $25,000 in bonds to guarantee the building of the road.

DALTON, MASS.—Ben Clow, a prominent resident, proposes to call a meeting of taxpayers about February 1 to take action in the matter of an electric railway for Dalton. He states that $15,000 can be raised in twenty-four hours for an electric railway to Pittsfield.

BALTIMORE, MD.—The contract for erecting the electrical equipment of the Edmonson avenue and Monument street lines of the Baltimore Traction Company has been awarded to J. G. White & Co., who have built all the other electric lines of the company.

HUMMELSTOWN, PA.—H. O. Koons, Dr. C. H. Smith, J. H. McIlhinney and other prominent citizens of Hummelstown accompanied a committee sent by the East Harrisburg Electric Motor Company to survey a route from the Jonestown road to Hummelstown.

SLATINGTON, PA.—The Slatington Street Railway Company, $30,000, has been incorporated. The following are the directors: Henry Buttner, John W. Balliett, H. W. Hanker, of Slatington, and Morris Hoats, of Allentown. The president is R. W. Mosteller, of Slatington.

JAMAICA, L. I., N. Y.—It is likely that the deal will be consummated for the purchase of the Hempstead and Jamaica Plank Road by the Long Island Traction Company, in which event a road would be built, forming a continuous trolley line from Hempstead to East New York.

BALTIMORE, MD.—A site has been selected at the intersection of Howard, Henrietta and Montgomery streets for a power house for the electric plant, which will supply the motive power which will be used in the Belt tunnel. Plans are being prepared and work will be begun in a few weeks.

PLAINVILLE, NORFOLK COUNTY, MASS.—Thomas Mears, John Kearn, Samuel Parquett and Herbert Britton, of Plainville, and Mr. Collinwood, of Holyoke, Mass., have been appointed a committee to canvass residents in the matter of an electric railway between Holyoke and Plainville.

FLUSHING, L. I., N. Y.—Residents of Flushing will attend a public meeting called by the Highway Commissioners for Feb. 6, in the matter of the application of the Brooklyn City Railroad Company for leave to build and operate a double-track electrical railway between the towns of Newtown and Flushing.

LEWISTON, N. Y.—The Lewiston and Youngstown Electric Railway Company will apply for right of way through the streets of the village, which will undoubtedly be granted, and they will light a portion of the streets free of charge. The capital stock is $75,000, and it is expected to have the road in running order by July 1.

BENWOOD, W. VA.—The preliminary survey for the proposed Benwood-Moundsville Electric Street Railway has been completed by Surveyor C. C. Smith, and the Benwood authorities have granted the right to lay double tracks from Fourth street to the town limits, provided an electric light is allowed to be placed on every pole.

HARTFORD, CONN.—The Hartford and West Hartford Railway Company has asked for permission to build and equip and operate by electricity a street line entering the city by way of New Park avenue. The Hartford Street Railway Company has also asked permission to extend its lines and change its motive power to electricity.

MOUNT HOLLY, N. J.—The Burlington County Electric Company, capital stock $125,000, has been organized to operate a trolley road between Burlington and Mount Holly. The incorporators are Jacob F. Burrows, James L. Greir and William B. Esler, of Philadelphia, Pa.; S. H. Morison, of Camden, N. J., and Robert B. Esper, Jr., of Ardmore, Pa.

BALTIMORE, MD.—A bill is being prepared for introduction at Annapolis for the incorporation of the Baltimore and Anne Arundel Street Electric Railway Company, $50,000 capital, with permission to increase to $500,000, and with permission to use electricity or any other motive power in use on railway lines. The upper terminus of the lines will be at Laurel, in Prince George county, Md.

FREDERICK, MD.—The bill to incorporate the proposed Frederick and Middletown electric road has been introduced by Senator Newman at Annapolis, Md. The capital is $100,000, and the incorporators named are Peter W. Shafer, Thomas H. Haller, Dr. Upton A. Sharretts and Charles V. S. Levy. It is stated on good authority that capitalists have taken hold and will push the project.

WEST ORANGE, N. J.—Residents of West Orange are up in arms against the proposed extension of the system of the Consolidated Traction Company to the foot of Eagle Rock, where it is proposed to connect it with an elevator to be built for the purpose of carrying visitors to the Summit Hotel, at the summit of the Rock. Thomas H. Nevins, of Centre street, Orange, is at the head of the project.

WHITE PLAINS, N. Y.—Owing to the absence of members of the Board of Trustees, the special committee were not allowed to read their reports in the matter of the franchises asked for by the New York, Mamaroneck and White Plains Railroad Company and the New York, Elmsford, and White Plains Railroad Company for trolley lines. Uuless President Husted calls a special session, there will be no meeting until Feb. 5.

MARTINSBURG, BLAIR COUNTY, PA.—The Martinsburg correspondent of the Altoona "Tribune" states: "It is now an assured fact that Morrison's Cove is to have rapid transit and a trolley line, which, beginning at Hopewell, in Bedford county, and terminating at Roaring Spring, in Blair county, will be built in the near future. The road will have two branches,one extending from the stone house to Enterprise, and another from Woodbury to Curryville. The title of the company will be the Morrison's Cove Electric Railway."

WASHINGTON, D. C.—All future incorporators of street railways in the District of Columbia, in the preparation of their charter, will have to conform to certain prescribed regulations laid down in a model bill just prepared by the Commissioners of the District. The feature about this measure that is of most interest to electrical readers lies in the fact that all future electric railways established there must furnish and maintain such electric lights along their lines as the authorities may direct, without cost to the District government, but no overhead wires shall be constructed or used within the limits of the city of Washington.

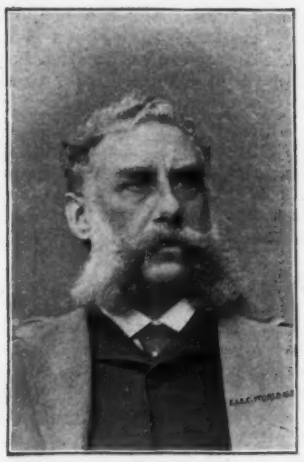
Legal Notes.

STATE PRIVILEGE TAX ON TELEGRAPH COMPANY.—A State privilege tax of a certain sum per mile of wires operated within the State, imposed on all telegraph companies therein operating in lieu of all other State, county and municipal taxes, and amounting to much less than the sum of a single ad valorem property tax, is not an interference with the interstate commerce of a foreign corporation. (Postal Telegraph Cable Co. v. Adams, Supreme Court of Miss., 14 So. Rep., 36.)

RIGHT OF ELECTRIC RAILWAY COMPANY TO REPAIR TRACK.—An order restraining a railway company, pending a suit, from entering on a road for the purpose of constructing an electric railway track, or incumbrance of any kind upon said road, or in any way preparing to lay such track, is not violated by operating and repairing a track theretofore built and used, the temporary removal of which has been required by the paving of a street. (Detroit and B. Plank Road Company v. Detroit Citizens' Street Railway Company, Supreme Court of Mich., 56 N. W. Rep., 940.)

Personal.

MR. WILIAM MERTENS, president of the Cataract General Electric Company, is a member of the foreign banking house in New York of L. von Hoffman & Co., which is well-known throughout Europe and America as one of the oldest and leading financial institutions. Mr. Mertens was born in Germany, and came to this country at an early age, after securing a liberal education at home. While still in his youth he entered the service of the banking house mentioned as foreign correspondence clerk, from which position he has been promoted, step by step, until he is now the head of the institution in this country in the absence of Baron von Hoffman. He is a man of middle age, of a commanding presence, and is regarded as one of the most conservative, yet energetic financiers in New York. He is found upon most of the leading reorganization committees,and his judgment upon all matters of finance and railroad management is eagerly sought by the most prominent operators. Mr. Mertens is greatly interested in the electrical development of Niagara, and devotes a considerable part of his time to the preliminary steps incident to the establishment of the great business which will follow the completion of the transmission line through the State.



MR. FRANK W. HAWLEY, vice president of the Cataract General Electric Company, is just 35 years of age, and but a few years ago was a poor boy in Rochester, working 18 hours a day in order to conquer adverse circumstances. He was accustomed to rise at a very early hour, take care of horses and a furnace, and to do other work around the house, all of which was remunerated by his board. At 9 o'clock he entered a law office, where he was employed as clerk and where he studied law when his office duties would permit. In the early evening Mr. Hawley began his duties in connection with one of the Rochester newspapers, sitting at his desk or reporting in the evening until midnight, then turning in for a few hours' sleep. The capacity for such labor after a few years brought appreciation and with it responsible posts, in which he revealed executive qualities of the highest order. This victory, however, was secured at a very great price; the work had produced paralysis of the optic nerve of one eye, and a sympathetic trouble with the other, so that it has cost him partial blindness. Mr. Hawley owns the former country place of the late ex-Senator Jarvis Lord, from which, with a great herd of Jerseys, he supplies butter to various New York hotels, and in his herd possesses some of the most famous Jerseys living. On Sunday or Monday nights he is in a sleeping car, at his place of business in New York City the following morning, and on Friday night is again on a sleeper, on his way to the stock farm. In New York he associates with those who expect to solve the problem of the development of electricity at Niagara, as well as towing or propulsive force for boats upon canals. It was he who recently conceived and demonstrated the feasibility of electricity for such purposes, as noted in our columns.

CHARLTON T. LEWIS, secretary and treasurer of the Cataract General Electric Company, is a Pennsylvanian by birth, son of the late Joseph J. Lewis, who was Commissioner of Internal Revenue under Mr. Lincoln, and grandson of Enoch Lewis, the famous Quaker mathematician and author. Mr. Lewis was educated at Yale College, where he was graduated in 1853 in an unusually brilliant class, which included Wayne Macveagh, Senator Randall Gibson, Andrew D. White, Edmund C. Stedman, and many other men of note. He was Deputy Commissioner of Internal Revenue in 1863 and 1864, and came from Washington to New York to practice law. He has continued active in the profession for nearly thirty years, but after a serious interruption of work in 1867 by ill health, took to editorial work for a while, and conducted "The Evening Post" for nine years, under the general editorship of William Cullen Bryant. Since his return to active work at the bar, he has found leisure to publish a number of works, among them a notable "History of Germany," and three widely used Latin dictionaries. At the New York bar, as a corporation lawyer, Mr. Lewis admittedly stands alone. His clientage in wealth and influence is probably greater than that of any other lawyer in the United States. Mr. Lewis' connection with electrical enterprises is supposed to have begun with the organization of the International Bell Telephone Company, about 1880, of which he has been a director, general counsel and chairman of the executive committee for many years. He was also one of the founders and directors of the Thomson International Electric Welding Company, and has given long and careful study to the practical problems arising in the application of electricity to the useful arts, and expresses strong confidence in the future utilization, by transmitted and stored electric force, of most important sources of power now unused.

Miscellaneous Notes.

THE CLEVELAND (OHIO) SCHOOL FOR CORRESPONDENCE was visited by the delegates of the Ohio Society of Civil Engineers and Surveyors on Jan. 17, who found much of interest in this new system of technical teaching.

LEHIGH UNIVERSITY.—Some changes have been made in the school of engineering. The subjects of alternating currents and surveying have been introduced in the junior year in place of machine design, which has been put into the sophomore year.

A SINGULAR ACCIDENT.—The ohm sifter of one of the large dynamos at the Wood Harvester Works became detached Thursday, thereby causing the ohms and volts to pass over the same wire. Had it not been for the presence of mind of Mr. King, the company's electrician, the automatic ampere controller would have been disabled.—Hazel Park, Minn., Times.

THE NEW ELECTRICAL LABORATORY AT PURDUE UNIVERSITY was dedicated with appropriate ceremonies on Friday, Jan. 19. This building was splendidly equipped for engineering work, and one of the finest in the country. On Tuesday, Jan. 23, the building caught fire and in less than an hour was all in flames. Practically nothing was saved but the instruments of the civil engineering department and the west wing of the building. The new laboratory represented a value of $100,000 in the building itself and $80,000 in equipment, on which there was a total insurance of $45,500.

THE MAGNETIC CLUB held its winter meeting and banquet at Jaeger's, corner 59th street, New York, on Jan. 18. Speeches were made by President Cockey, William J. Dealy, Robert F. Straine, Theodore L. Culyer, Jr., Walter C. Burton, Francis W. Jones, and an otherwise interesting programme of entertainment, humor, songs, etc., was enjoyed. At the annual business meeting of this popular club on Jan. 11 the following officers were elected: Edward C. Cockey, president; William H. Baker, first vice president; John Brant, second vice president; Thomas E. Fleming, third vice president; George H. Usher, fourth vice president; George F. Fagan, secretary ; W. C. Burton, treasurer.

Trade and Industrial Notes

LACONIA, N. H.—The Laconia Car Company announces its intention of engaging extensively in the business of manufacturing cars.

THE KEYSTONE ELECTRIC COMPANY, of Erie, Pa., will equip the extensive Brodhead woolen mills at Jamestown with motors and dynamos.

THE DELAWARE ELECTRIC AND SUPPLY COMPANY, Wilmington, Del., has just shipped an 80-h. p. boiler to Florida, and a 50-h. p. boiler to Washington, D. C.

F. A. CULIN & SONS, electrical contractors, 809 Provident Building, Philadelphia, are distributing among their friends and patrons a particularly neat calendar.

MR. DAVID CHALMERS, manager for S. H. Milbank, 67 Cortlandt, street, New York, receiver of the A., B. & C. Co., is fast closing out the remainder of the stock of the late company.

I. W. NESS & CO., Montreal, Can., have issued a catalogue (No. 7) devoted to telephones, in which are described their main line, warehouse and automatic telephones, switchboards, and various telephone supplies.

JULIUS ANDRAE, 225 West Water street, Milwaukee, Wis., was burned out on the 13th inst., with a loss of $12,000, which is covered by insurance. Temporary quarters have been secured adjoining the former ones.

CHAS. A. SCHIEREN & CO., 47 Ferry street, New York, have issued a new catalogue of their perforated electric leather belting, which, among other interesting information, contains a list of some of the unusually large belts that this firm has made.

MR. McLEOD, of McLeod, Ward & Co., 91 Liberty street, New York, reports the demand for the Kinsman Desk Lamp steadily increasing. Mr. McLeod is about to place upon the market a portable desk lamp, which he claims is far superior to any similar desk lamp now in use.

THE SHULTZ BELTING COMPANY, of St. Louis, Mo., has just received an order from England for 2,800 feet of belting, and an order from Russia for 15,000 feet of belting. It also reports that trade is looking up and orders are coming in freely, and that the outlook for business is fair.

BARTLETT & CUSHMAN, Concord, N. H., proprietors of the Granite State Electric and Machine Company, exhibited at their office, 31 South Main street, Thursday afternoon, Jan. 18, a new triphase motor manufactured for Messrs. Silsby & Son, and soon to be installed in their printing office.

MR. A. L. ELLIS, manager of the Snow Steam Pump Works, Buffalo, N. Y., reports that his company has not in any way experienced the "dull times" complained of by so many; on the contrary, the works have been constantly run to their full capacity, and a large annex, just completed, was built to better facilitate the prompt manufacture of this company's product.

THE ELECTRIC ENGINEERING AND SUPPLY COMPANY, of Syracuse, N. Y., reports an exceedingly lively time in special work, as its switchboard and large station switch department is particularly active in that line of work, although the lines in staple goods are reported comparatively dull. Many large and handsome switchboards have been recently turned out of its works, which do much credit to the high quality of work which this company is turning out.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received the contract for an iron roof for the boiler and engine room of De Land & Co., at Fairport, N. Y. The roof will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. The new mill of the Diamond Mills Paper Company, Millbank, N. J., is being put in place by the same company, which has also received an order for an iron roof from the Citizens' Gas Company, of Brooklyn, for their new produce house.

THE ELECTRIC APPLIANCE COMPANY was well represented at the Milwaukee Convention of the Northwestern Electric Light Association by its president, William W. Low, and by Mr. Frank McMaster with samples of its leading specialties. The "Finest of the Wheat," a special circular for the convention, setting forth the merits of the Standard Push Switch, Washington Arc Lamp, Packard Mogul Lamp and Packard Transformer, attracted considerable attention, and was favorably received by the many station managers present.

MR. W. H. McKINLOCK, president of the Metropolitan Electric Company, Chicago, Ill., was in town last week, and left for the West Saturday. During his stay in New York Mr. McKinlock secured the Western agency for the sale of the P. & B. insulating compounds, manufactured by the Standard Paint Company, New York, and will hereafter keep a large amount of this company's specialties in stock. Mr. McKinlock, who is also the Western agent for the sale of "N. I. R." wires and cables, reports large sales of the Metropolitan incandescent lamp.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, about a year ago issued a pamphlet on lubricating graphite. It embodied an elaborate scientific opinion by Prof. R. H. Thurston on the value of graphite as a lubricant, and much interesting information on the subject from practical men. The pamphlet has had a large circulation, and the company has been enabled to obtain from well-known men a vast amount of additional knowledge on the uses of graphite. Another pamphlet, twice the size of the former, will be issued early in February.

QUEEN & CO., INC., Philadelphia, are about to bring out a line of standard voltmeters on the "hot-wire" plan, made under the fundamental "Cardew" and other more recent patents. These instruments prove extremely accurate for both direct and alternating circuits, which is confirmed by an award received at the World's Fair for "success attained in overcoming the defects of the ordinary hot-wire instrument, viz., lack of great range through which the instrument is sensitive, great correction due to change of temperature and inconstancy of zero point, and also for its compactness, portability and excellence of mechanical construction."

MR. FRANK S. DE RONDE, general sales agent of the Standard Paint Company, 2 Liberty street, New York, says that during the past year his company has sold more P. & B. insulating material than any preceding year. There is hardly a place in the country where insulating compounds are required but what you will find P. & B. Mr. De Ronde has lately made arrangements with Mr. William H. McKinlock, president of the Metropolitan Electric Company, Chicago, to act as Western agent, and Messrs. Pettengell-Andrews Company, of Boston, to act as New England agents. The specialties manufactured by the Standard Paint Company placed in the hands of two so well-known companies as the above, should increase the large and growing demand for the P. & B. insulating compounds.

THE LA ROCHE ELECTRICAL WORKS, of Philadelphia, Pa., put in the following installations during the month of December: Robert H. Forderer, Frankfort, Philadelphia, 1,500-light machine; Duncan, Hood & Co., Philadelphia, 400-light machine; Thomas Devlin, Philadelphia, 500; Allegheny Woolen Mills, Philadelphia, 300; Emery Hotel, Philadelphia, 300; Westborough Electric Light and Power Company, 1,000; Boloxi Electric Light and Power Company, 1,000; Quincy Electric Light and Power Company, Mass., 1,300; Yale College, laboratory apparatus; also motors aggregating 150 h. p. The company has also booked orders for January aggregating 8,000 lights and motors, amounting to 78 h. p., and is running day and night with double facilities in order to comply with the increasing demand for its lighting machines.

THE GENERAL ELECTRIC COMPANY has secured a large slice of the street railway car equipment contracts awarded during the last ten days in Philadelphia. Of 250 contracted for by the People's Traction Company, 125 equipments with the G. E. 800 motors and type K controllers were purchased from the General Electric Company, while the remaining 125 were allotted to the Sperry Company, of Cleveland. Of 80 equipments required by the Electric Traction Company, of Philadelphia, 70 will be furnished by the General Electric Company. The People's Traction Company had already contracted for three of the great 1,500 k. w. General Electric generators. It has also secured contracts during the past week covering 20 car equipments for the Union Railroad Company, of New York; 25 car equipments for the Steinway Railroad, of Long Island; one 700-h. p. generator for the Steinway Railroad, of Long Island; eight 300-k. w. generators for Cincinnati, and 10 car equipments for the St. Louis Street Railway, of St. Louis.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED JAN. 16, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

512,711. RAIL BOND FOR ELECTRIC RAILWAYS; H. R. Keithley, Chicago, Ill. Application filed Feb. 27, 1893. This comprises a bond rod or wire having tubular or thimble-shaped ends and secured to the rails by having its ends swaged into holes in the rails by means of a pin.

512,723. ELECTRIC INHALER; R. L. Larcom, Fandon, Ill. Application filed Sept. 29, 1893. This consists of a casing, tubes and syringe bulb connected thereto, a slide fitting in the casing, a battery carried by the slide, and sponges connected to the terminals of the battery circuit.

512,744. ELECTRIC SWITCH; E. P. Warner, Chicago, Ill. Application filed Dec. 1, 1891. This comprises two pair of contact plates, and a switch-block sliding between the members of the pair to make contact therewith, the sliding block being provided with a handle.

512,754. RAILROAD SIGNAL; C. Selden, Baltimore, Md. Application filed Feb. 1, 1893. The combination with a stop-wheel

and connection rod of a semaphore, of a yielding tooth for permitting the stop to pass the connection rod freely in one direction.

512,757. PROCESS OF MAKING SECONDARY BATTERY PLATES; W. L. Silvey, Dayton, Ohio. Application filed Sept. 12, 1892. This consists in immersing anodes of lead alloy and cathodes of lead in a solution of ammonia and an acid and then disintegrating the anodes by an electric current and electrically depositing the parts thus decomposed in holes in the cathode.

512,769. MACHINE FOR WINDING ELECTROMAGNETS; R. Varley, Jr., Englewood, N. J. Application filed April 13, 1893. This comprises a turning head for rotating a bobbin, and a frame provided with guides through which the strands pass to the bobbin, the guides being placed in a plane transverse to the axis of the bobbin.

512,797. ELECTRIC HEATER; W. J. Bowen, Norwalk, Ohio. Application filed April 14, 1893. This comprises a series of vertical air tubes, each provided with an insulating jacket, a heating coil around the jacket of each tube having its terminals confined by clamps, to which are fastened insular blocks and conductors.

512,805. SWITCHBOARD; W. A. Childs, Englewood, N. J. Application filed Oct. 25, 1893. In an electric switchboard, a flexible cord conductor, both ends of which terminate in a block forming a part of the face of the board, the block being held in place by friction. (See illustration.)

512,820. MOTOR GENERATOR; J. C. Henry, Westfield, N. J. Application filed April 29, 1892. The combination of field magnets, two armatures carried by a single shaft and a single support for the shaft between the armatures.

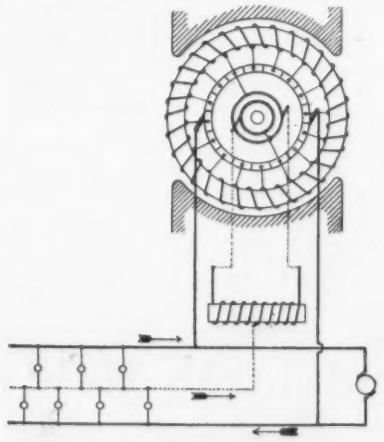
512,821. CEILING FAN MOTOR; W. Hochhausen, Brooklyn, N. Y. Application filed Sept. 4, 1891. This comprises a supporting head, field magnet cores bolted thereto, a journal-bearing cap, closely fitted at its periphery to the field magnet, and an armature having its vertical bearing on the cap.

512,823. SECONDARY BATTERY; A. Hough, San Francisco. Application filed Sept. 14, 1893. The method of constructing active material consisting in mixing monoxide of lead, sulphate of ammonia and sulphate of magnesia, and when mixed decomposing the sulphate of ammonia and dissolving the sulphate of magnesia.

512,843. DYNAMO-ELECTRIC MACHINE; H. S. Rodgers, Hartford, Conn. Application filed Jan. 31, 1893. A dynamo provided with field magnet cores having pole tips or horns formed integral with the body of the cores and lying within planes bounding the external surface of the cores.

512,853. COMMUTATOR AND CONNECTION FOR DYNAMOS; G. Wilkes, Detroit, Mich. Application filed Oct. 2, 1893. In a dynamo, a cross-connection for the commutator consisting of an arm, provided with a slitted projection, and an elastic strip provided with a bent tip at one end and a straight tip at the other.

512,872. SEXTUPLEX TELEGRAPH; T. A. Edison, Menlo Park, N. J. In a multiplex telegraph, differential relay magnets in the



No. 513,006.—CONTINUOUS CURRENT DISTRIBUTING SYSTEM.

respective circuits in combination with shunt connections in the respective circuits around the relay magnets and condensers of equal or nearly equal electrostatic capacity in the respective shunts.

512,880. ELECTRIC ARC LAMP; C. J. Hartley, Decatur, Ill. Application filed March 31, 1893. The combination of a spool having a derived circuit wire, a clutch carrying core controlled by and movable in the upper end of the spool, and a core adjustable in the lower end of the spool by means of a set-screw.

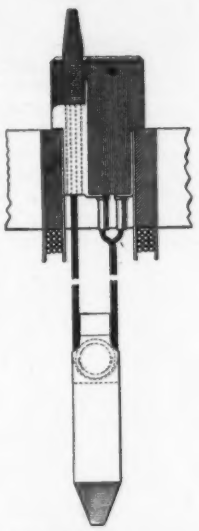
512,888. TROLLEY WIRE INSULATOR; H. H. Luscomb, Hartford, Conn. Application filed Oct. 18, 1893. This comprises a case and an insulated connection within the same, a cap within the case having recesses therein, and projections on the case, which are bent over the cap and received in the recesses therein.

512,907. BATTERY SYSTEM FOR ELECTRIC RAILWAYS; L. B. Rowley, Ashland, Wis. Application filed Feb. 15, 1893. The system of distribution for electric railways consisting of a main circuit including in multiple arc two or more independent sets of batteries, a working circuit and means for automatically switching the sets of batteries bodily and individually from one circuit to the other. (See illustration.)

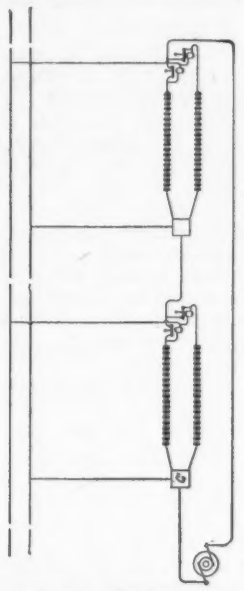
512,923. ELECTRIC RAILWAY TROLLEY; W. Van Benthuysen, New Orleans, La. Application filed March 24, 1893. This comprises a pair of conical trolley wheels mounted in a swinging frame and oppositely arranged with respect to each other.

512,962. EXCITANT FOR VOLTAIC CELLS; G. Hewett, New York, N. Y. Application filed April 3, 1893. This consists of sulphuric acid, sulphate of soda and bisulphate of mercury prepared in a dry state.

513,006. CONTINUOUS CURRENT DISTRIBUTING SYSTEM; M. Von Dolivo-Dobrowolsky, Berlin, Germany. Application filed Nov. 24, 1893. In a system for distributing electricity to two series connected groups of consuming apparatus by the aid of two main conductors and a compensating conductor, the combi-



No. 512,805. SWITCHBOARD.



No. 512,907.—BATTERY SYSTEM FOR ELECTRIC RAILWAYS.

nation with the compensating conductor and a continuous current dynamo connected with the mains of a coil of high self-induction connected at both ends with diametrically opposed points of the armature winding of the dynamo, and in its centre with the compensating conductor. (See illustration.)

513,023. ELECTRIC RAILWAY TROLLEY; G. W. Mackenzie, Beaver, Pa. Application filed April 5, 1893. A trolley having independent rollers with inclined downwardly converging surfaces.

513,052. ELECTRIC SEARCH LIGHT; C. E. Ongley, New York, N. Y. Application filed Aug. 22, 1893. Means for supporting and adjusting a search light, consisting of a base upon which is seated and pivoted to move horizontally a bracket having two arms between which is pivoted to move vertically a reflector, the horizontal movement being controlled by a shaft passing through the base, and the vertical movement by a bar passing through the shaft and bearing upon the reflector at an eccentric to its pivotal point.

513,062. AUTOMATIC REGULATOR FOR DYNAMO-ELECTRIC MACHINES; W. A. Sperry, Cleveland, Ohio, and G. E. Mills, Ravenswood, Ill. Application filed April 25, 1892. In an electric machine, rotating magnet coils and frame constituting the field of the machine, a rotator therefor, a revolving part carrying the armature, and a connection from the revolving armature or part to the rotator.

513,065. AUTOMATIC ELECTROMAGNETIC SWITCH; H. P. White, Philadelphia, Pa. Application filed Sept. 25, 1893. The combination of a switch plate and its resistances, a swinging switch arm having an armature, a magnet mounted to rotate in proximity to the armature, and worm-gearing for rotating the magnet.

PATENTS EXPIRED JAN. 23, 1894.

186,453. ELECTROMAGNETIC TELEGRAPH APPARATUS; Robert K. Boyle, New York, N. Y.

186,476. ELECTRIC TRAIN SIGNALS; L. L. Ferris, New York, N. Y.

186,548. TELEGRAPHIC ALARM AND SIGNAL APPARATUS; T. A. Edison, Menlo Park, N. J.

186,553. ELECTRIC THERMOSTATS; E. J. Frost, Philadelphia, Pa.

186,572. ELECTRIC RAILROAD SIGNALS; J. D. Hughson, Prairie City, Ill.

186,642. ELECTRIC MOTORS; D. Ward, Binghamton, N. Y.